

2014

Corporate Energy Management Plan



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Corporate Energy Management

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1 Introduction

1.1 Executive Summary

The City of Markham is a rapidly growing municipality with a population of over 310,000 residents in Canada's most diverse community. Markham is projected to grow by 150,000 residents and 100,000 jobs by 2031; coupled with increasing fuel prices, the City's energy consumption, energy demand, and greenhouse gas emissions are more important than ever to fully understand and manage. To address these issues, the City established the following goals for our Corporate Energy Management Plan:

1. To position the City to move toward the Greenprint's goal of "net zero energy, water, waste and emissions by 2050".
2. To support the Corporate Goal of a "Safe and Sustainable Community" where "We will protect the public and respect the natural and built environments through excellence in sustainable community planning, infrastructure management, and programs."
3. Develop a Corporate Energy Management Plan that meets the requirements for O.Reg 397/11: Energy Conservation and Demand Management Plans and Partners in Climate Protection Milestone's Two and Three.

Markham is a firm believer in the management adage, "Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it"¹. With a comprehensive corporate energy management plan, Markham is positioning itself to benefit in several key areas:

- Reduce Energy consumption, greenhouse gas emission, and energy cost
- Reduce maintenance resources and costs, and extend equipment life
- Improve reliability and efficiency
- Improve quality for occupants
- Improve role as leader in Sustainability
- Reduce risk to volatile energy prices
- Increase energy supply security
- Promote local economic development

The least expensive methods of controlling utility costs is managing the energy required to successfully operate as a municipality and educating the individuals who use that energy in the organization. Figure 1: Relative Fuel Production Costs demonstrates that concept by comparing the relative costs of fuel production to energy efficiency.

¹ Harrington, Total Improvement Management

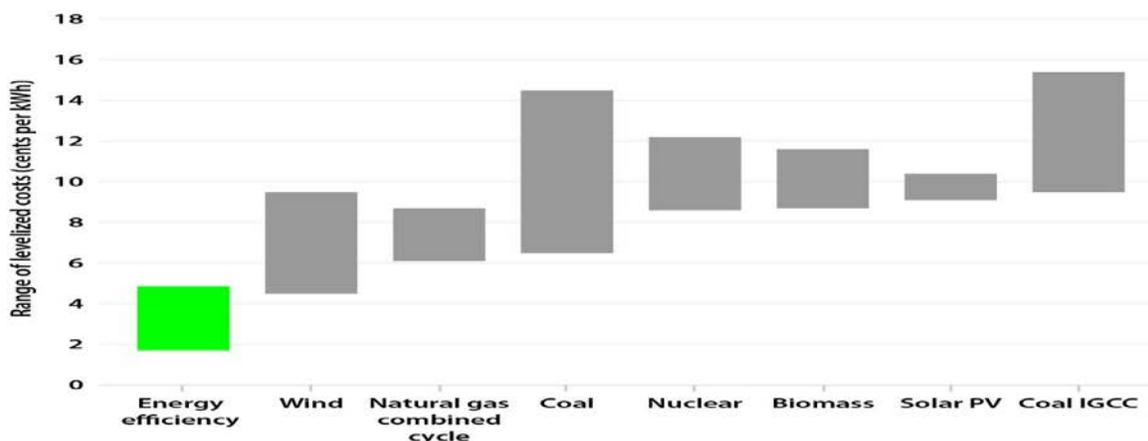


Figure 1: Relative Fuel Production Costs²

Therefore, the City of Markham’s focus is centred on 3 major approaches: retrofitting or replacing existing equipment with equipment of a higher efficiency or more efficient control method; designing and constructing new facilities with energy efficient technology and controls; and investing in renewable energy to expand on community resilience, reduce greenhouse gas emissions, and generate revenue.

Table 1: CEMP Measures - Estimated Costs and Savings is a high-level summary of the measures separated by resource categories recommended throughout the CEMP. **It should be noted that the energy retrofit measures cannot be spent independently, but rather should be viewed collectively, to achieve the desired payback. The table outlines the estimated expected expenditure in order to save the estimated cumulative annual savings against the baseline. All of the savings accumulated by each measure will carry over into subsequent years. The Energy Retrofit Capital Project category will follow the City of Markham’s procedures of requesting projects through the annual capital budget process.**

City of Markham Recommended CEMP Measures – Estimated Costs and Savings	
Type of Measure	2014-2019 Total
Estimated Cost for Energy Retrofit (Capital Budget) ¹	\$1,095,000
Estimated Cost for Energy Retrofit (EEM Staffing Soft Cost) ²	\$377,000
Estimated Cost for Energy Retrofit (City Staffing Cost) ³	\$175,000
Estimated Total Cost for Energy Retrofits	\$1,647,200
Estimated Cumulative Total Savings	\$2,026,725

Table 1: CEMP Measures - Estimated Costs and Savings

¹ Capital Budget costs to fund energy retrofit projects and best practices with attractive paybacks

² Staffing/soft costs of embedded energy manager (EEM) to implement best practices and projects with attractive paybacks. The EEM is an existing member of staff and not a new financial request

³ Staffing/soft costs of City facility staff to assist in implementing best practices with attractive paybacks. These staff costs are existing costs and not a new financial request

² Fierce Energy Fuel Comparison

The City of Markham, working in conjunction with the current Embedded Energy Manager (MECO Coordinator), intend on using the CEMP to plan for multi-year project planning, budgeting, energy and cost forecasting, and policy setting. The preliminary cost and savings estimates were based on several projects planned over the next few years that were prioritized according to return on investment, lifecycle, low risk/ease of implementation, repeatability, and resolving persistent issues.

Much of the anticipated spending in new construction is derived from the City’s mandated standards to achieve LEED Silver (or better) for new construction and major renovations, as well as expanding on Markham District Energy’s efficient district energy system. New construction, major renovations, and renewable energy were not included in this table, and will be confirmed on a case by case basis.

The staffing/soft costs of existing facility City staff to coordinate, manage, and monitor energy projects were estimated based on assumed hours and rates for existing staff to implement the energy projects. The projected staffing resource costs were calculated to assist in forecasting existing staff time allocations to various projects in the following years.

Through the Green Energy Act, Ontario Regulation 397/11 was established in 2009 to direct all public agencies to annually report energy consumption and greenhouse gas emissions beginning July 1st, 2013 and every year thereafter. Additionally, Ontario Regulation 397/11 mandated that all public agencies prepare, report, and implement energy conservation and demand management plans by July 1, 2014.

The Corporate Energy Management Plan (CEMP) will use the following template to highlight the energy conservation and demand management measures proposed in the plan along with estimated costs, energy and cost avoidance, and length of time to initiate and execute the measure. The measures in the template are recommendations in each major section of the plan to aid in achieving the goals, targets, and objectives defined in the plan.

Measure	Cost	Savings	Length
Proposed measure	Proposed cost	Proposed savings	Proposed length

1.2 Purpose of Energy Management Plan

The Corporate Energy Management Plan (CEMP) was created to improve the City of Markham’s energy management strategies, resources, and effectiveness. Money not spent on energy bills is money that can be spent in other community and corporate initiatives without affecting taxes. The CEMP illustrates key areas for actions that the City intends on pursuing to better manage energy and maintain its status as a Leader in Sustainability. The CEMP is intended to meet all of the criteria established by; Ontario Regulation 397/11: Energy Conservation and Demand Management Plans, International Organization for Standardization (ISO) 50001, and Partners in Climate Protection’s (PCP) Corporate Milestones Two and Three. All three standards pertain to understanding existing energy consumption within the organization, establishing energy management systems, and developing action plans to reduce energy consumption and greenhouse gas emissions.

2 City of Markham Background

Energy Management is an increasingly important topic with respect to the environment, residents, and organizations as society progresses and resources become more limited. The conventional finite energy resources – electricity, natural gas, coal, and oil – are extracted and generated at a high price economically, socially, and environmentally. Consequently, management is placing greater emphasis on creating and implementing strategies to mitigate these costly effects.

The City of Markham established the Markham Energy Conservation Office (MECO) in 2005, through funding support from the City of Markham and its local distribution company PowerStream, with a vision to position the City of Markham as a leader and municipal champion in energy conservation.

MECO is responsible for leading, developing and implementing energy conservation programs that deliver realistic demand shedding and cost avoidance results, and are in line with the Provincial goals of creating a ‘culture of conservation’.

MECO’s portfolio of programs is broad-based and includes initiatives that are focused on improving internal operations by implementing retrofit projects in existing facilities as well as working to ensure new facilities are built to a higher, more efficient standard. In addition, MECO provides an employee awareness program on energy for City staff.

In 2009, MECO joined the newly formed Sustainability Office. MECO, via the MECO Coordinator, is now positioned to play a key role in the preparation and implementation of the Greenprint, Markham’s Community Sustainability Plan, and to handle expanded responsibilities, including Climate Change. Aligning the Greenprint’s objectives with the CEMP increases the likelihood of both plans succeeding.

The Embedded Energy Manager Program is a program offered through PowerStream and the Ontario Power Authority that will fund up to 80% of the energy manager’s salary, subject to several criteria that collectively improves Markham’s energy consumption. Some of the criteria includes: the creation of an energy management plan, initiating and executing projects that will save Markham 300 kilowatts of demand energy and just under 1,800,000 kilowatt-hours of consumption energy annually, developing an energy awareness program, benchmarking similar buildings against each other and the industry averages, and performing high level assessments on the buildings with the most potential to save energy.

The first action taken by the Sustainability Office for the CEMP was to recognize where the City's strengths, weaknesses, opportunities for improvement, and threats were in the energy planning process. The City used high-level matrices, developed by Natural Resources Canada, to critique its performance and investigate its opportunities for improvement. Each category was rated on a scale from zero to four; with zero having the greatest room for improvement and four equating to high proficiency with little room for improvement. The figures below outline the high-level matrices findings –see Appendix A: CEMP Self-Assessment Tool for greater detail on how the ratings were derived. The area with greatest opportunity for improvement is in the Monitoring & Targeting section. The CEMP was designed to improve on all categories with particular focus on its areas for largest growth.

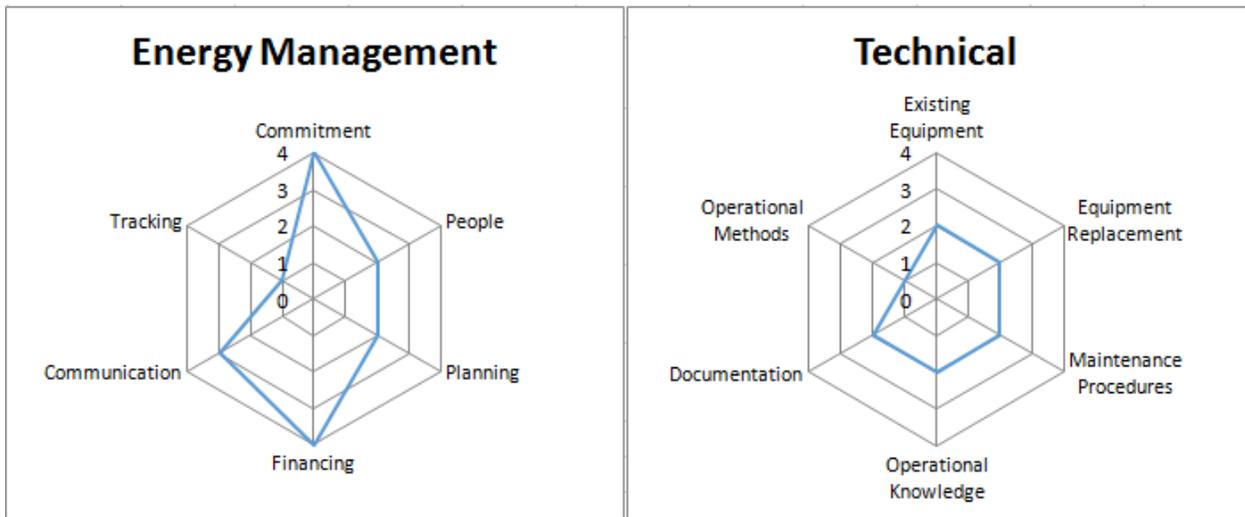


Figure 2: Energy Management, Technical High-Level Survey Results

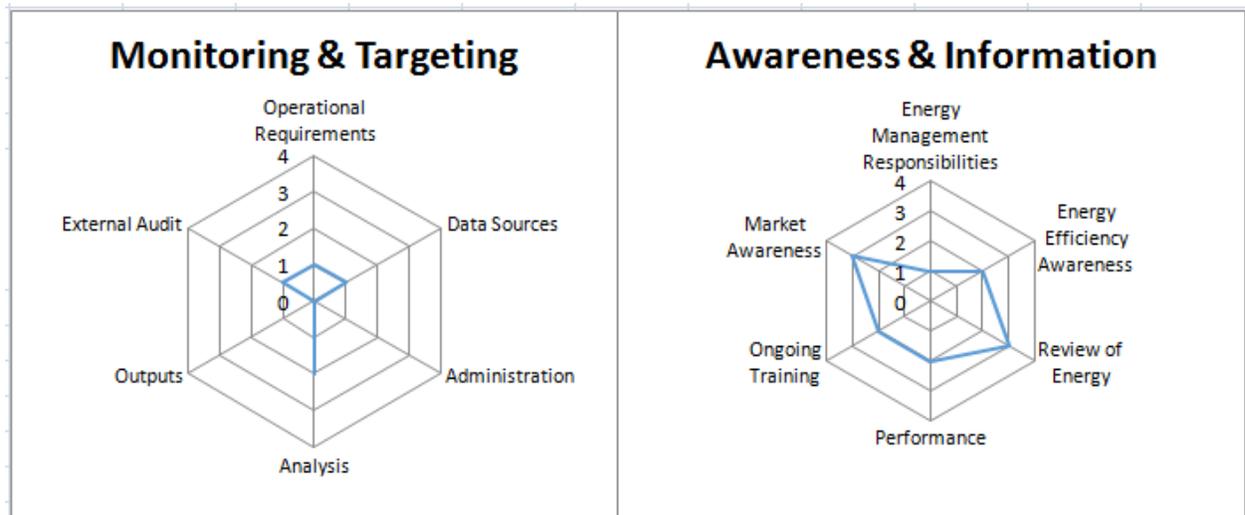


Figure 3: Monitoring & Targeting and Awareness & Information High-Level Survey Results

2.1 City of Markham Profile

In order to develop an effective and efficient energy management plan, the City of Markham’s first needed to determine its baseline energy and financial metrics. MECO completed energy audits in buildings with the highest intensities and several of the best performing facilities to identify transferrable best practices, potential retrofit measures, and areas to further reduce energy consumption and greenhouse gas emissions.

The Markham Energy Conservation Office (MECO) collaborated with the Finance and Asset Management departments, and Humber College, to develop comprehensive summaries of the City of Markham’s building data, energy consumption, operating costs, and greenhouse gas emissions for 2012. The Humber College students used the building data provided by the City to assist in benchmarking the City’s building inventory and comparing the facilities using various metric techniques. The City focused on the buildings defined by the criteria outlined in the Green Energy Act, which were mainly buildings that are occupied, heated and cooled, as well as water treatment facilities.

2.1.1 Building Information by Gross Floor Area

Using all existing and confirmed records available for 2012, the following tables and graphs illustrate the divisions sorted by gross floor area, facility type, and quantity. Overall, the community centres with indoor ice rinks occupy the highest percentage of gross floor area. Several of the building type categories are contained within one building so there is overlap between facility function. For example, one community centre may contain an indoor ice rink, open community centre space, an indoor court, and an indoor swimming pool.

City of Markham Facility Type Relative to Gross Floor Area		
Category	Number of Facilities	Gross Floor Area (ft ²)
Indoor Ice Rinks	8	394,209
Community Centres	14	272,279
Administrative	5	201,384
Gym and Indoor Courts	7	125,106
Public Libraries	6	113,881
Fire Halls	10	95,945
Maintenance Facilities	7	69,787
Cultural Facilities	9	58,338
Indoor Swimming Pools	3	54,613
Art Galleries	2	28,116
Parking Garages	1	16,598
Indoor Recreational Facilities	1	10,106
Auditoriums	1	4,733
Pumping Facilities	7	3,977
Total	81	1,449,072

Table 2: Facility Type Relative to Gross Floor Area

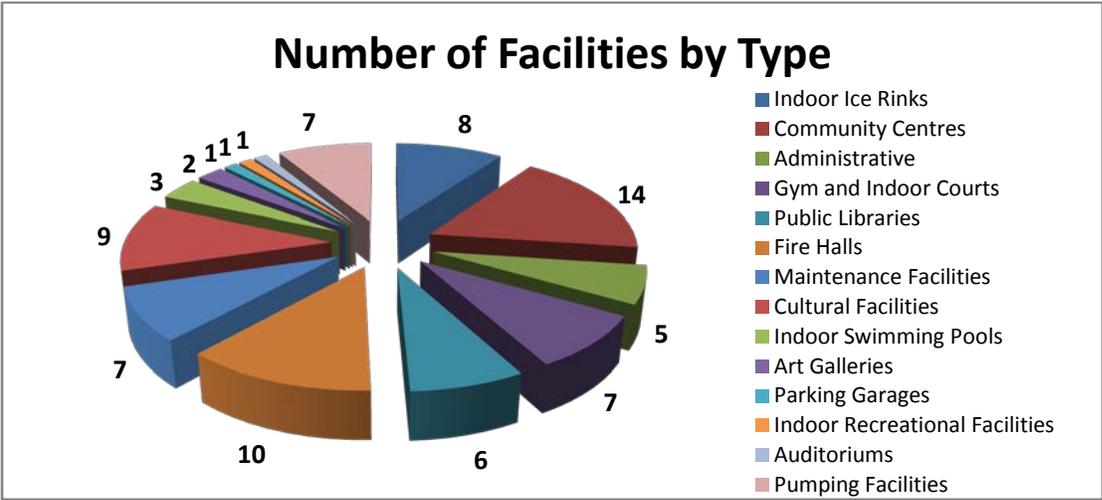


Figure 4: Number of Facilities by Type

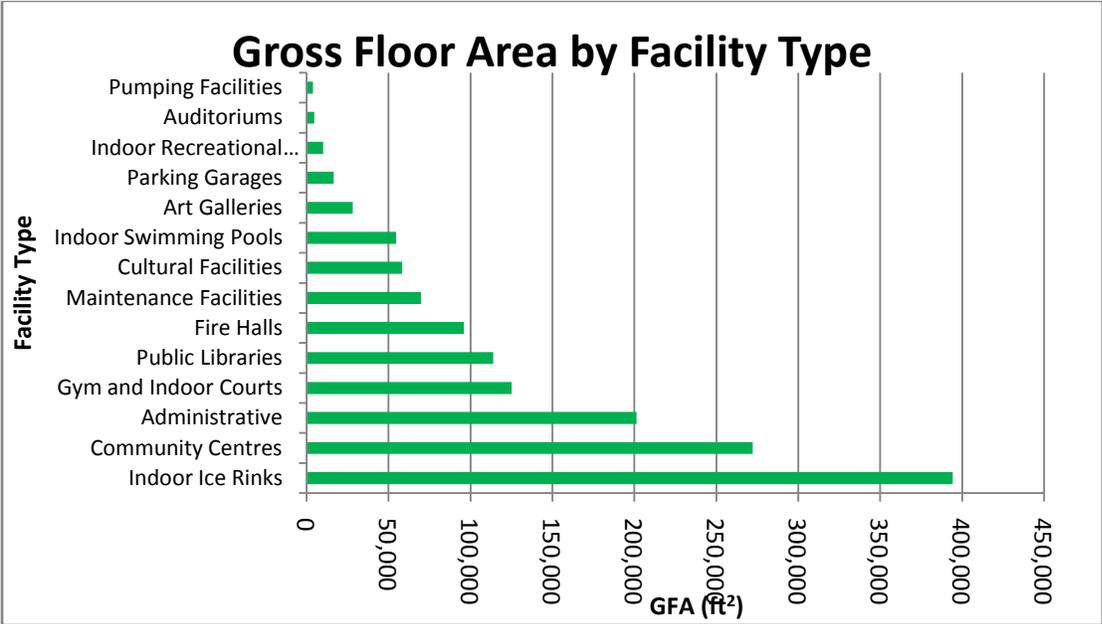


Figure 5: Gross Floor Area by Facility Type

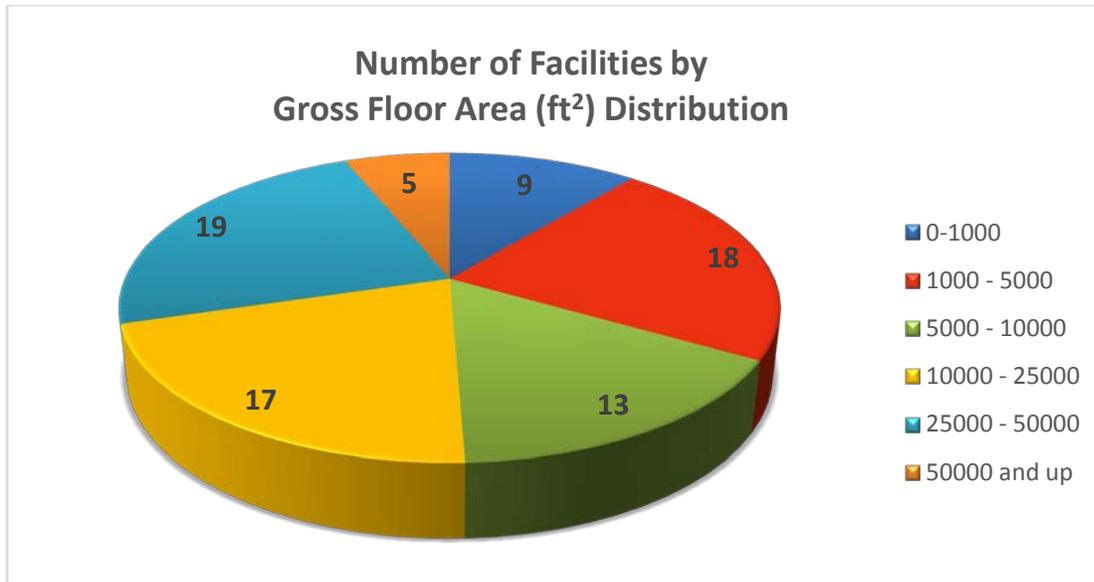


Figure 6: Number of Facilities by Gross Floor Area Distribution

2.1.2 Building Information by Age and Gross Floor Area

The facilities were then ranked by building age to determine the quantity of new versus older buildings as well as when the highest percentages of buildings were constructed. Between the years of 1980 to 1989, the City of Markham opened the doors for 22 new facilities marking that timeframe as the period of largest building construction. The summaries can be viewed in the tables and figures below.

City of Markham Facility Age Relative to Gross Floor Area		
Building Age Category	Number of Facilities	Gross Floor Area (ft ²)
Before 1920	10	35,032
1920-1959	5	45,056
1960-1969	5	57,400
1970-1970	11	327,162
1980-1989	22	388,477
1990-1999	12	280,026
2000-2010	11	205,921
After 2010	5	109,998
Total	81	1,449,072

Table 3: Facility Age Relative to Gross Floor Area

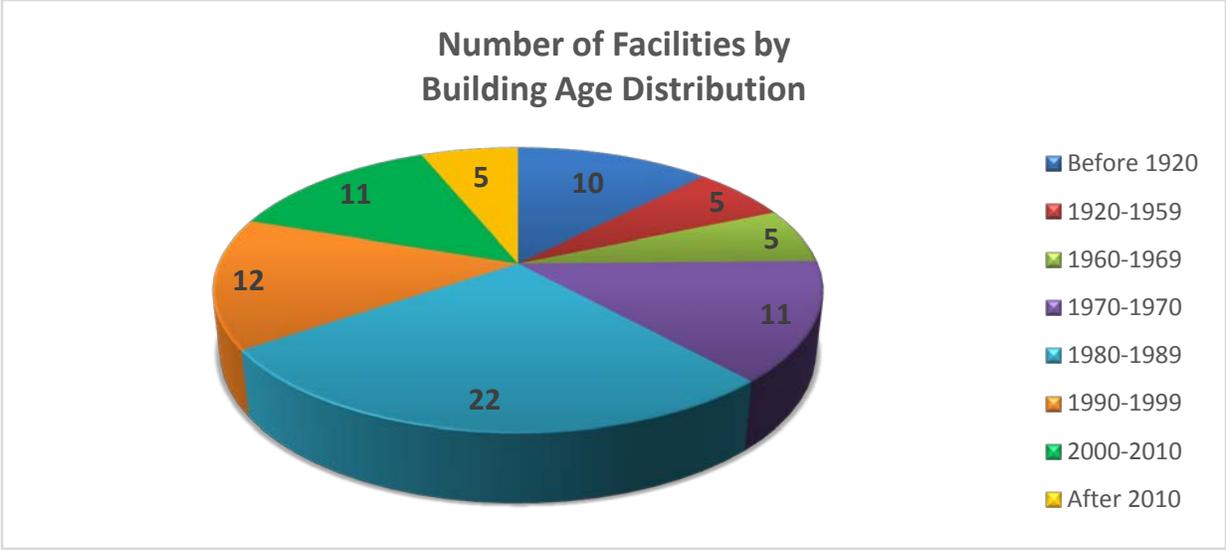


Figure 7: Number of Facilities by Building Age Distribution

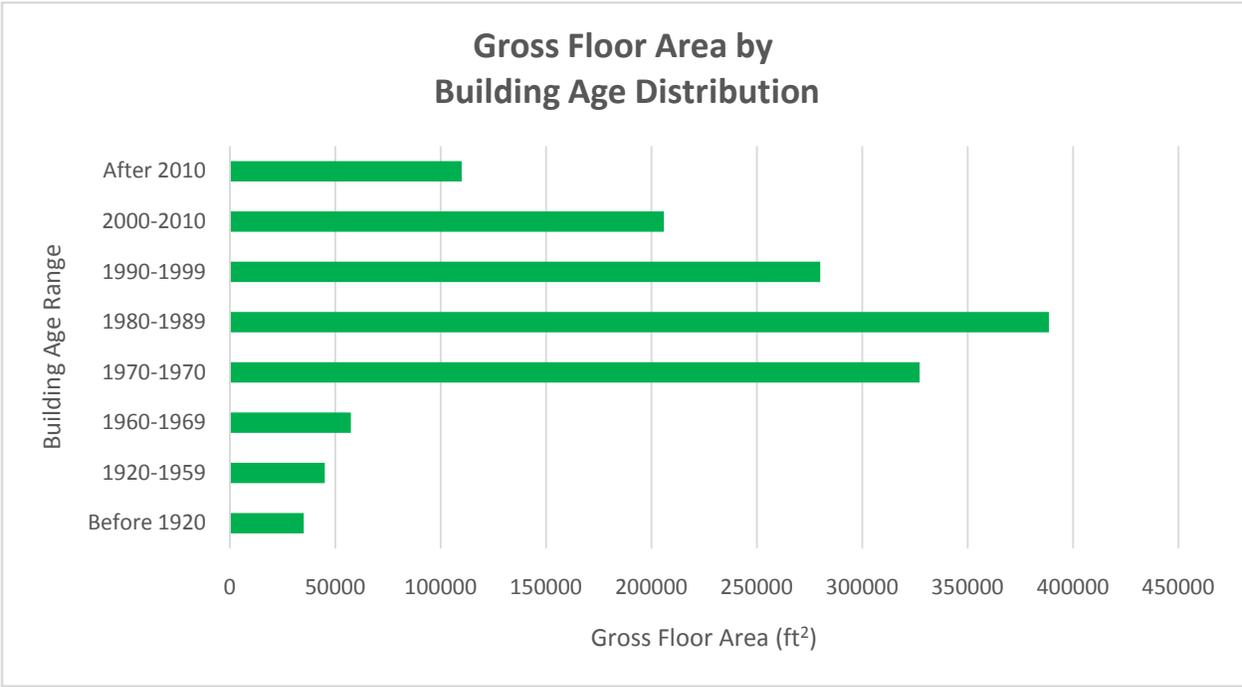


Figure 8: Gross Floor Area by Building Age Distribution

2.1.3 Energy Intensity

Once the City of Markham’s 81 major facility background information was determined, the City calculated energy use intensity (EUI) in equivalent kilowatt-hours per square foot, and grouped the buildings by facility type. The results can be viewed in the table and figures below. The pumping facilities and indoor swimming pools account for the largest energy intensities in the City’s portfolio.

City of Markham Facility Type Relative to Energy Use Intensity Per Year				
Category	Number of Facilities	Electricity EUI (kWh/ft ²)	Natural Gas EUI (kWh/ft ²)	Total Energy EUI (ekWh/ft ²)
Pumping Facilities	7	64.6	-	64.6
Indoor Swimming Pools	3	22.9	37.2	60.1
Public Libraries	6	23.4	25.0	48.4
Community Centres	14	20.0	25.3	45.3
Art Galleries	2	18.8	24.8	43.6
Auditoriums	1	16.1	18.4	34.5
Indoor Ice Rinks	8	21.5	15.2	36.7
Gyms and Indoor Courts	7	20.9	12.0	32.9
Indoor Recreational Facilities	1	14.1	20.2	34.4
Fire Halls	10	11.3	20.6	32.0
Maintenance Facilities	7	11.5	20.1	31.6
Administrative	5	12.9	11.2	14.1
Parking Garages	1	14.2	-	14.2
Cultural Facilities	9	3.0	10.8	13.9
Total	81	17.7	17.5	35.25

Table 4: Facility Type Relative to Energy Use Intensity

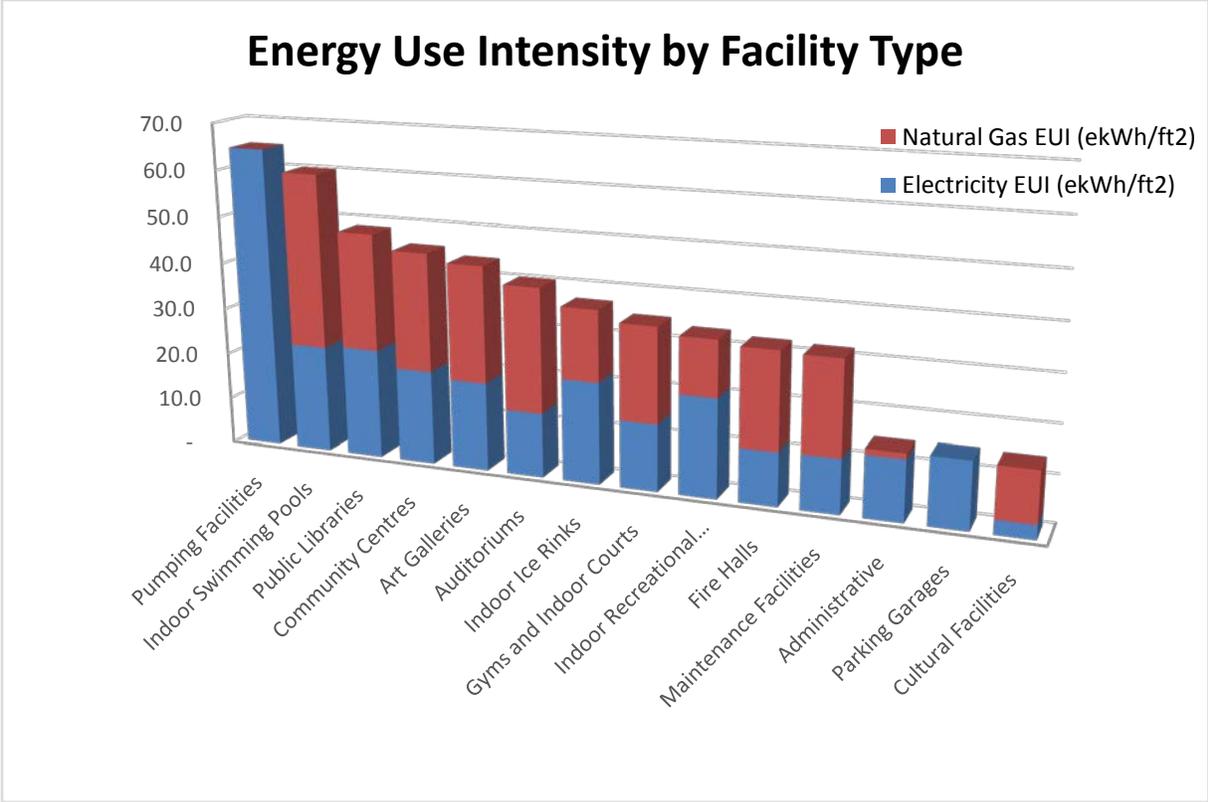


Figure 9: Energy Use Intensity by Facility Type

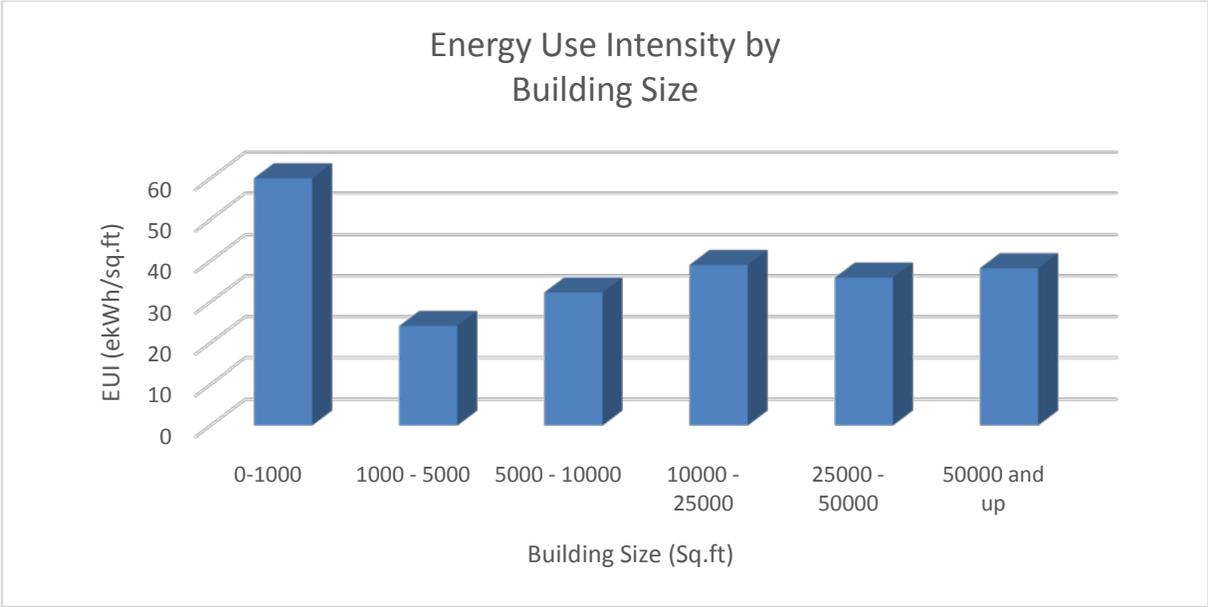


Figure 10: Energy Use Intensity by Building Size

The City of Markham has several different types of metering and accounting structures ranging from Time of Use (TOU), similar to residential, all the way up to large energy usage accounts on the Hourly Ontario Energy Price (HOEP) market. Some of the City’s accounts support not only electricity consumption monitoring but also electricity demand monitoring. Table 5: City of Markham Facility Type Relative to Peak Demand Electricity Use Intensity summarizes the facilities that track electricity demand and compares building types with the highest peak demand relative to buildings with the lowest peak demand.

City of Markham Facility Type Relative to Peak Demand Electricity Use Intensity Per Year					
Facility Type	# of facilities	Gross Floor Area (ft ²)	Total Peak Demand (kW)	Average Peak Demand (kW)	Demand Intensity (W/ft ²)
Recreation Complex/Arena	11	841,650	4,601.5	418.3	5.47
Municipal Building/Office	3	265,239	1,042.9	347.6	3.93
Library	2	33,201	320.9	160.4	9.66
Pumping Station	4	2,438	630.7	157.7	258.68
Cultural	4	123,209	498.3	124.6	4.04
Fire Station	3	34,590	129.0	43.0	3.73
Total	27	1,300,327	7,223.3	1251.6	5.55

Table 5: City of Markham Facility Type Relative to Peak Demand Electricity Use Intensity

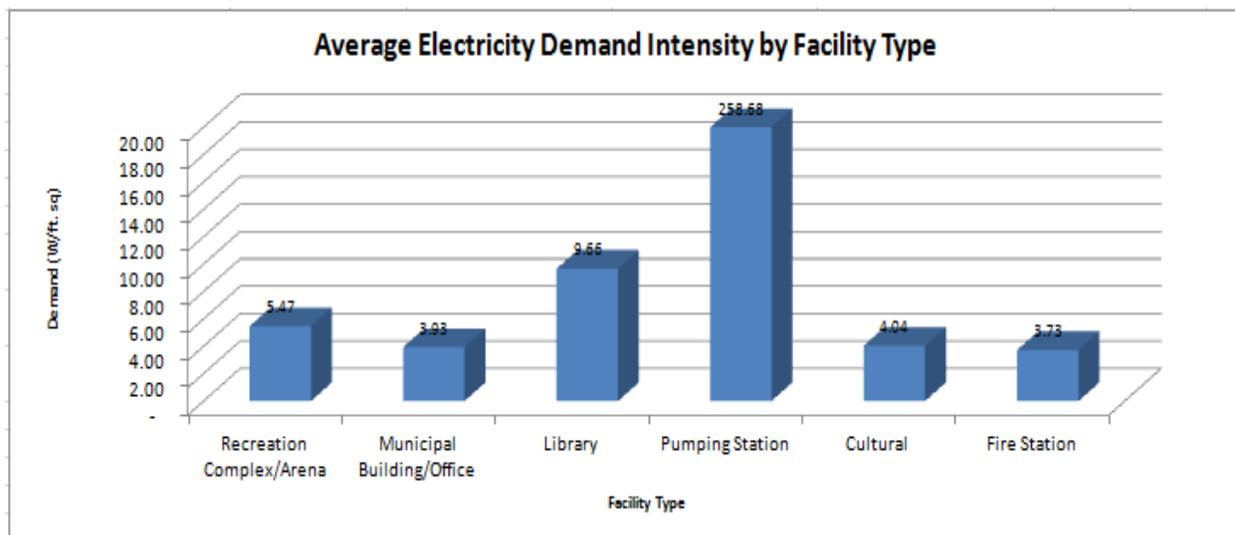


Figure 11: Average Peak Electricity Demand by Facility Type

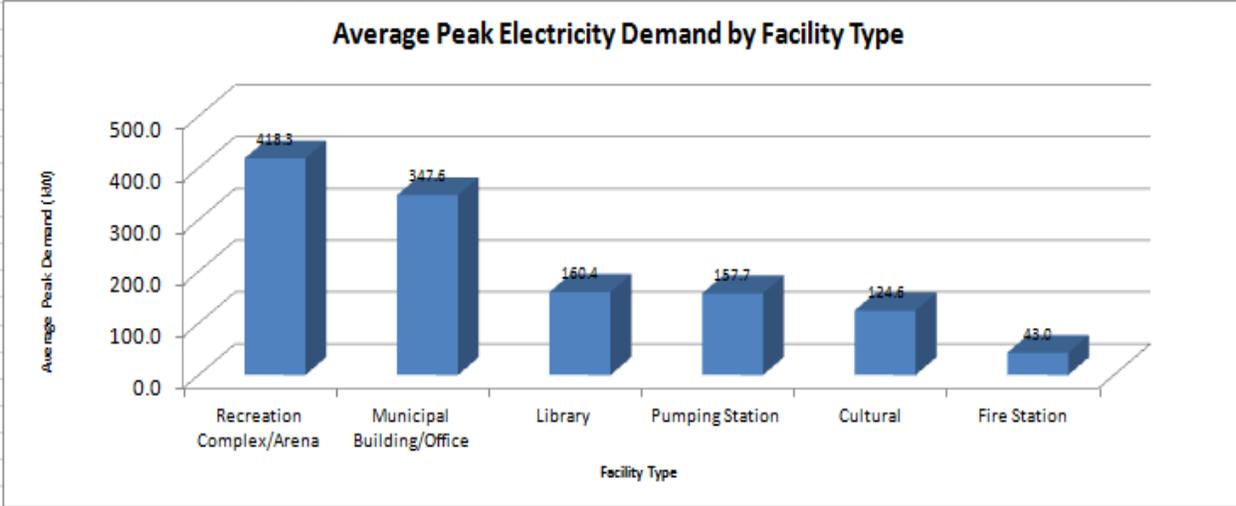


Figure 12: Average Peak Demand Intensity by Facility Type

2.1.4 Water Consumption

The community centres use the overwhelming majority of water consumed by the City of Markham. The results for total water consumed by facility type are available in the table and figure below. Although water consumption was not a reporting requirement under Ontario regulation 397/11, Markham recognized the important role water plays in managing energy consumption and finite resources and thus decided to include water management in its CEMP.

City of Markham Water Usage by Facility Type	
Facility Type	2012 Total Water Consumption (m ³)
Community Centres	167,190
Administration Building	24,084
Fire Stations	9,186
Public Libraries	4,018
Art Galleries	2,427
Cultural Facilities	1,985
Storage Facilities	852
Total	209,742

Table 6: Water Usage by Facility Type

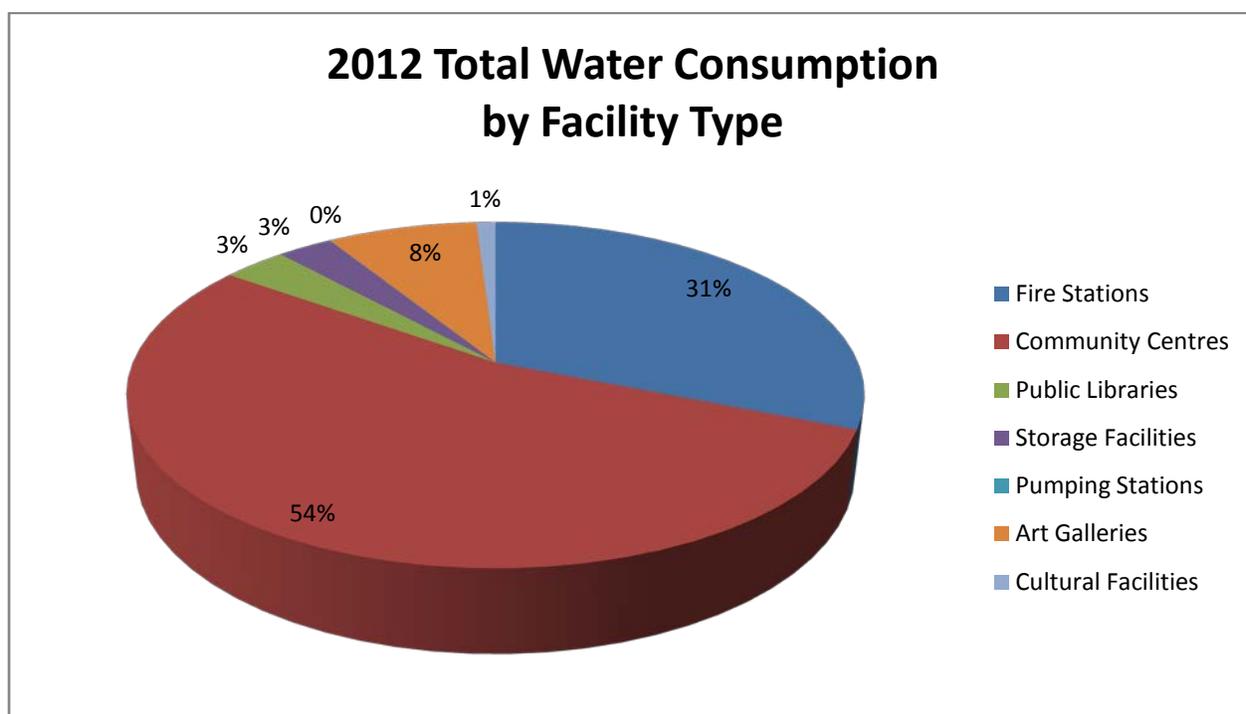


Figure 13: Water Consumption by Facility Type

2.1.5 Greenhouse Gas Emissions

The City of Markham tallied its fuel inventory and analyzed each fuel source’s greenhouse gas (GHG) emissions in kilograms per year using the Ontario Regulation 397/11 calculation spreadsheet and the Partners in Climate Protection Milestone Tool, developed by ICLEI Canada, for the remaining fleet fuel sources. Facility natural gas emissions dominated the total GHG emissions produced by the City of Markham, with Facility electricity as the second main GHG emissions source.

2012 Corporate Greenhouse Gas Emissions by Source	
Source Category	Total CO ₂ e(Kg)
Facilities - Natural Gas	4,122,911
Facilities - Electricity	2,555,168
Traffic & Street Lights	1,760,710
Fleet - Unleaded Fuel	855,104
Fleet - Biodiesel B5	566,866
Fleet - Biodiesel B20	458,827
Facilities - Steam/Hot Water	412,245
Facilities - Chilled Water	100,057
Propane	84,042
Total	10,914,929

Table 7: Corporate GHG Emissions by Source³

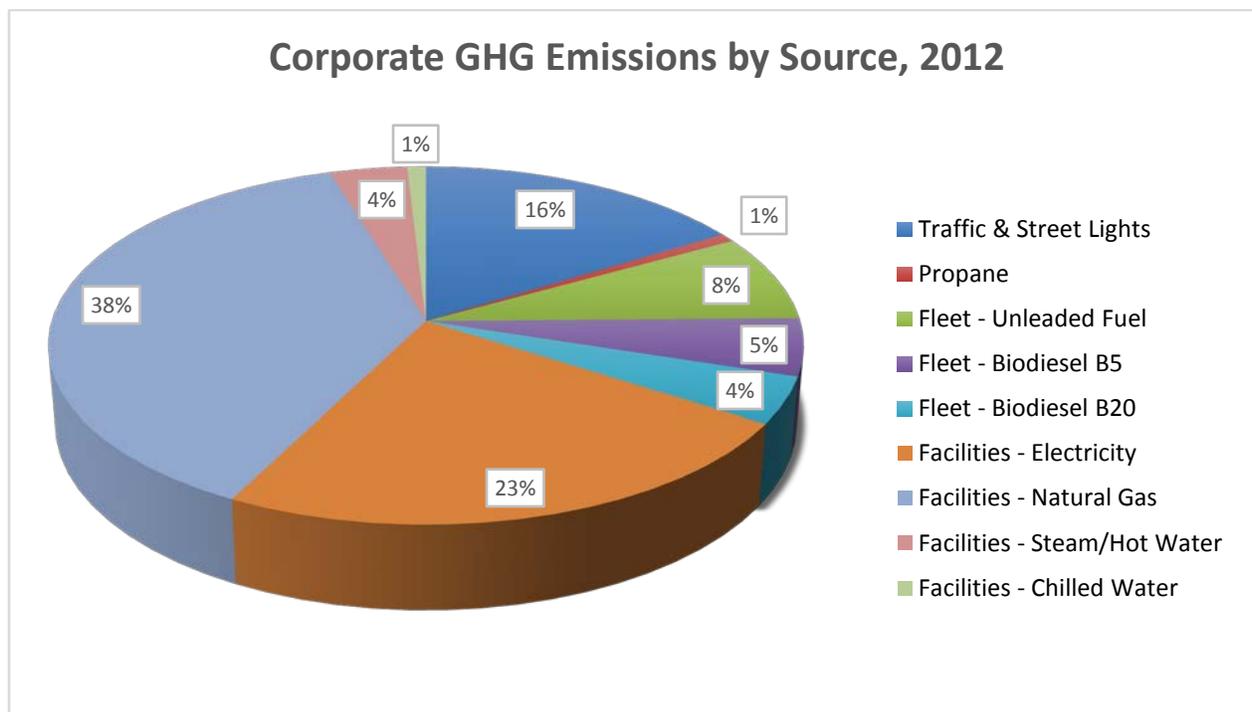


Figure 14: Corporate Greenhouse Gas Emissions by Source

³ CO₂e emissions are calculated using the Partners for Climate Protection Milestone Tool developed by ICLEI Canada (www.icleicanada.org/pcptool) and Ontario Regulation 397/11 GHG Calculation Spreadsheet

City of Markham Greenhouse Gas Emissions by Facility Type 2012			
Category	Number of Facilities	Total Energy (GJ/year)	GHG Emissions (Kg) CO ₂
Indoor Ice Rinks	8	52,200	1,821,619
Community Centres	14	44,570	1,662,881
Public Libraries	6	19,913	729,034
Gyms and Indoor Courts	7	15,553	588,176
Indoor Swimming Pools	3	11,858	454,385
Fire Halls	10	11,088	429,854
Maintenance Facilities	7	7,967	307,619
Administrative Facilities	5	10,252	301,405
Art Galleries	2	4,432	166,159
Cultural Facilities	9	2,928	120,089
Indoor Recreational Facilities	1	1,201	40,912
Pumping Facilities	7	1,041	29,138
Auditoriums	1	687	26,820
Parking Garages	1	849	23,743
Total	81	184,540	6,678,090

Table 8: Greenhouse Gas Emissions by Facility Type

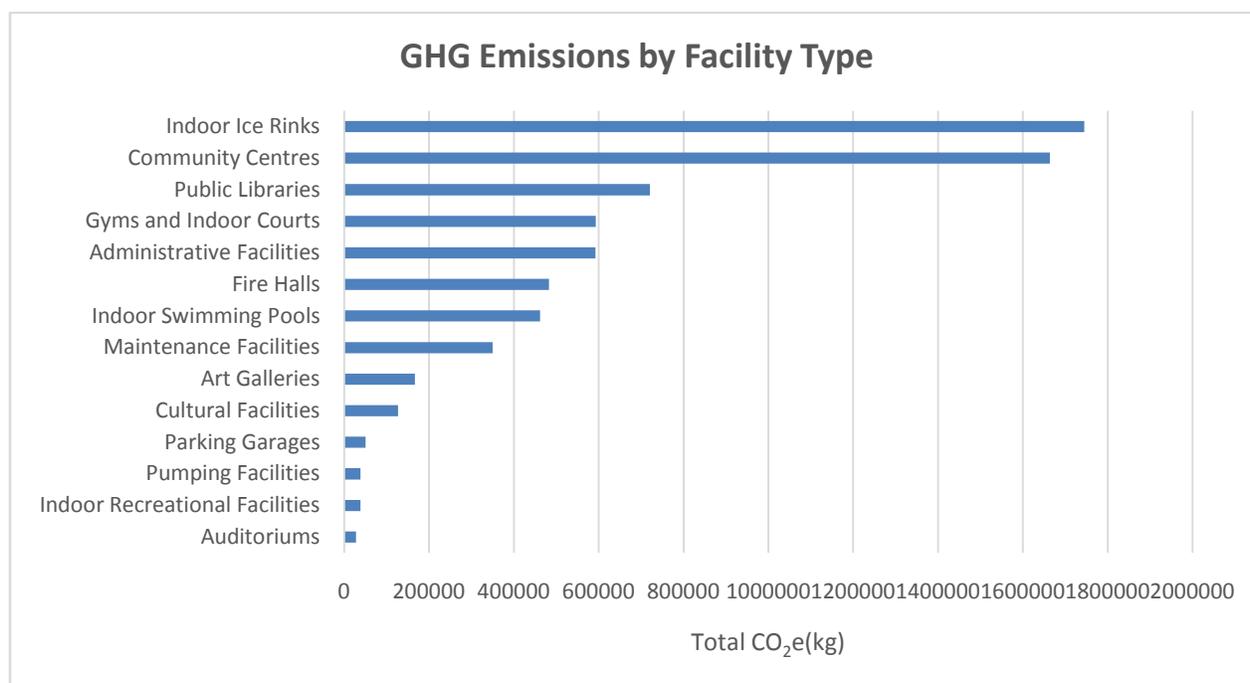


Figure 15: GHG Emissions by Facility Type

2.1.6 Corporate Energy

The overall consumption and cost by energy source for the City of Markham is outlined in the table and figures below. When the streetlight and facility electricity data is combined, electricity is the most consumed and highest costing resource utilized by the City of Markham. The top three highest fuel costs are: Facility electricity (\$3,072,645), street & traffic lights (\$2,374,730), and facility steam/hot water (\$1,267,224/year). In 2012, 23,674 streetlights spanned throughout the City of Markham consuming 17,644,048 kWh of electricity and 3,822 kW of demand at a cost of \$2,374,730 annually.

2012 Annual Energy Consumption and Cost		
Fuel Source	Energy Consumption (GJ/year)	Cost (\$/year)
Facilities - Electricity	92,179	\$ 3,072,645
Street & Traffic Lighting	63,519	\$ 2,374,730
Facilities - Steam/Hot Water	45,258	\$ 1,267,224
Facilities - Natural Gas	92,361	\$ 554,653
Fleet - Unleaded Fuel	14,350	\$ 432,500
Fleet - Biodiesel B5	9,161	\$ 276,100
Fleet - Biodiesel B20	8,919	\$ 262,200
Facilities - Chilled Water	4,596	\$ 225,204
Propane	1,519	\$ 37,000
Total	331,862	\$ 8,502,256

Table 9: Annual Energy Consumption and Cost

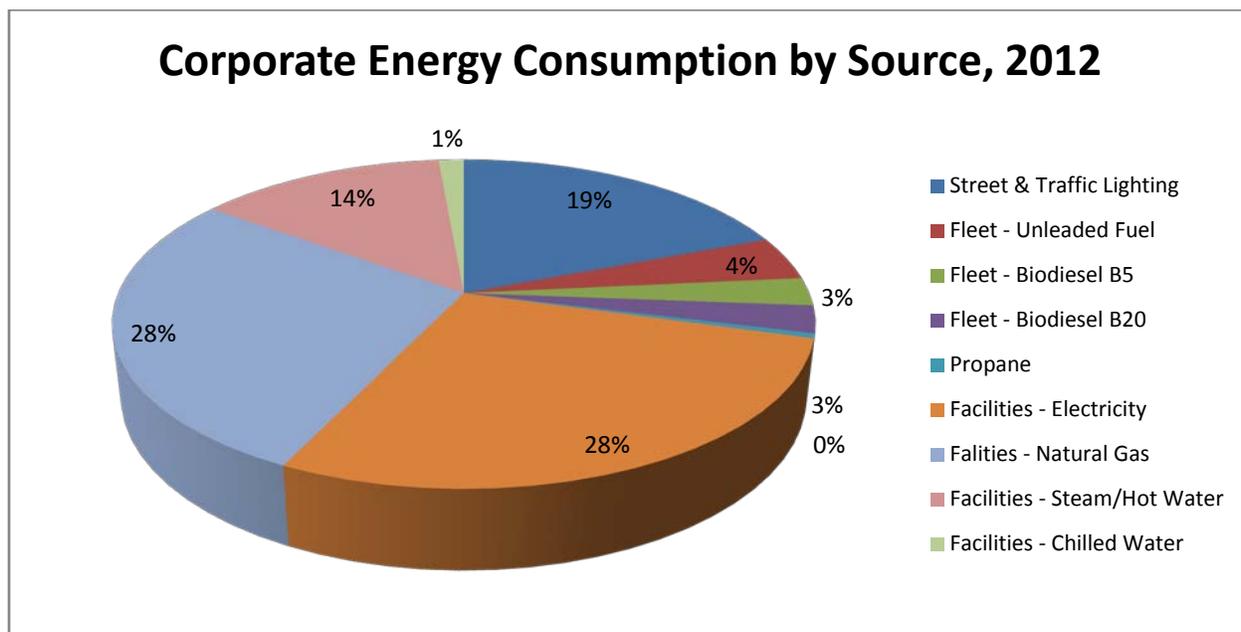


Figure 16: Percentage Corporate Energy Consumption by Source

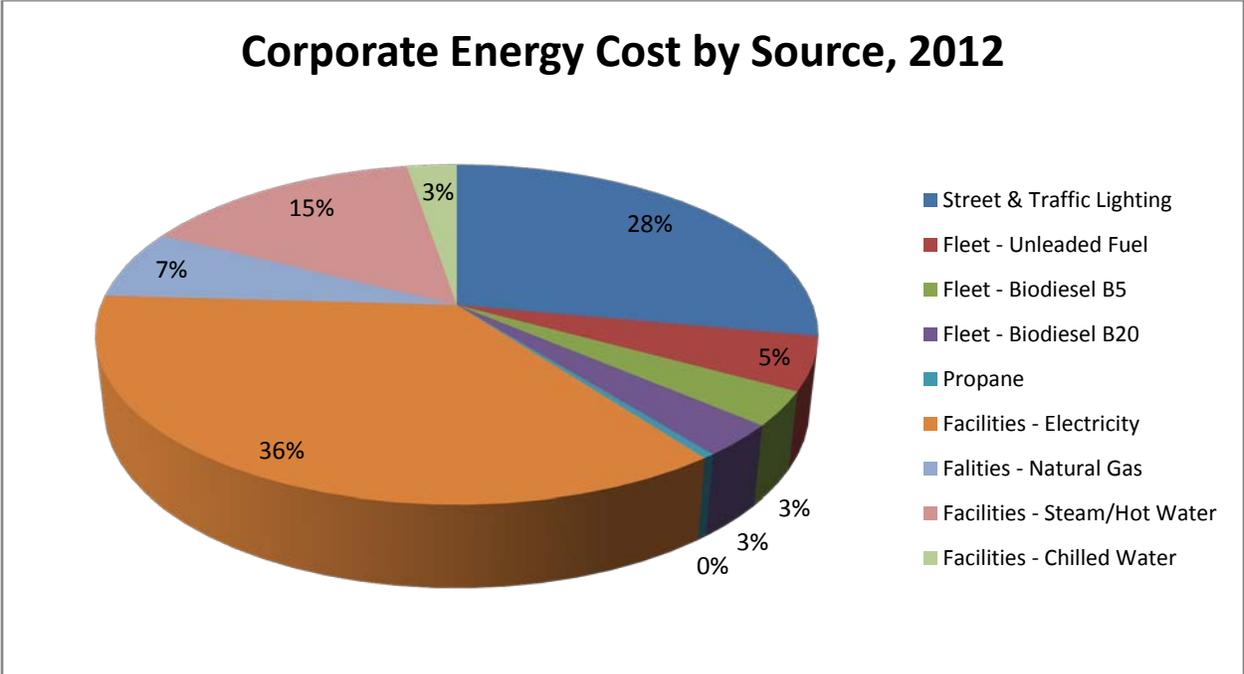


Figure 17: Percentage Corporate Energy Cost by Source

2.2 Energy & Environmental Management Policies

In 2011, the Greenprint was endorsed by Council as a plan for Markham over the next 100 years to become one of the most sustainable communities in North America. The energy objective of the Greenprint is to achieve net-zero energy, water, waste, and emissions by 2050. Through energy conservation and renewable energy production, Markham is anticipating reaching its net-zero energy goal by 2050. Additionally, the Greenprint’s intent for the City is to provide community leadership in sustainability and encourage innovation in the Sustainability field. Table 10: Energy and Environmental Management Policies defines policies and programs managed by the City of Markham that pertain to energy and environmental management.

City of Markham Energy & Environmental Management Policies		
Policy/Program	Purpose	Benefits to the City
Greenprint	<ul style="list-style-type: none"> - Long term sustainability plan - Integrates all initiatives, plans, programs, policies, and decision making frameworks towards a common goal - Aims to maximize quality of life for entire municipality 	<ul style="list-style-type: none"> - Reduces redundancy amongst other initiatives, plans, and programs - Streamlines policies and decision-making framework - Maximizes value for entire municipality
Corporate Energy Management Plan	<ul style="list-style-type: none"> - Comply with O.Reg 397/11 to create a corporate energy management plan - Report on energy consumption and GHG emissions - Outline goals and plan to reduce energy consumption and mitigate demand for energy 	<ul style="list-style-type: none"> - Allows the City of Markham to accurately track energy consumption and identify areas where energy conservation measures will be most effective
Markham’s Official Plan	<ul style="list-style-type: none"> - Plan describing multi-level municipal council’s policies and land usage - Plan outlines council actions on air quality, climate change, noise & vibration, brownfield & site remediation, conservation areas, water management, and much more 	<ul style="list-style-type: none"> - Identifies natural environments and strategies for protection - Cooperatively works with the Region and other partners to align policies and address key concerns
LEED Certification	<ul style="list-style-type: none"> - Build buildings to a higher level than the Ontario Building Code. - Improve construction practices to a higher standard than conventional building practices. - Build efficient buildings and reduce energy use in buildings. - Provide a better and healthier working environment for staff and visitors. - Achieve Silver level or higher, as directed by Council 	<ul style="list-style-type: none"> - Save money on energy usage in buildings through efficiency and conservation. - Increase water savings throughout buildings. - Reduction of waste and materials through construction and over the life time of the building.
Corporate Green Procurement	<ul style="list-style-type: none"> - Integrate environmental performance considerations into the procurement process 	<ul style="list-style-type: none"> - Reduce the environmental impacts of procurement while simultaneously realizing a slight decrease in life-cycle costs

City of Markham Energy & Environmental Management Policies		
Policy/Program	Purpose	Benefits to the City
Meatless Mondays	<ul style="list-style-type: none"> - Educate public on resource and energy intensity associated with meat production 	<ul style="list-style-type: none"> - Reduce embodied energy & negative environmental impacts associated with meat consumption - Increase food security
Zero Waste	<ul style="list-style-type: none"> - Markham Zero waste program vision is to achieve an 80% diversion of waste by 2014. - Ten new initiatives to reach 80% diversion of waste. - Maximize Recycling and composting city-wide. - Provide recycling collection to Homes, Multi-residential, Apartment/townhouse units, Schools, Business Improvement Areas. 	<ul style="list-style-type: none"> - Maximizes the reduction of waste in the city from the point of purchase. Reduces poor packaging design and inefficiency. - 5 Community Recycling Depots provide enhanced recycling of special materials. - Community Recycling Depots accept materials to be recycled that cannot be taken from the curb.
Fleet Vehicles	<ul style="list-style-type: none"> - Purchase vehicles with higher fuel economy and promote more economical driving through education - Purchase or modify cars to use cheaper fuel 	<ul style="list-style-type: none"> - Lower operating costs of municipal fleet vehicles
Markham Environmental Sustainability Fund	<ul style="list-style-type: none"> - Municipal program that funds innovative and leading environmental initiatives that contributes to the sustainability and health of the natural environment. - Provides financial resources for projects in Markham that promote environmental responsibility and protection of natural resources. 	<ul style="list-style-type: none"> - Improves energy efficiency through initiatives/ pilot projects. - Implementation and promotion of green roofs, water management, clean air, wildlife habitat restoration, and rainwater harvesting. - As a result from these initiatives it will help reduce the implication of climate change and reach goals of Kyoto.
Markham Organic Home Garden Program	<ul style="list-style-type: none"> - Encourages residents to grow organic food at home and donate the surplus produce to their local food bank. - Award participants with certifications from workshops provided by the city. - Provides tips and newsletters to members containing recipes to help gardening skills. 	<ul style="list-style-type: none"> - Provide access to safe, affordable, and healthy food. - Opportunity to borrow gardening tools and access to seed library. - Community can help with demand of organic grown food.
Adopt-A-Park	<ul style="list-style-type: none"> - Works with volunteers in community to be active in their local green - Allows community members to become involved in keeping spaces clean and green in the neighbourhood. 	<ul style="list-style-type: none"> - Keeps parks clean from litter by volunteers actively participating in cleanups. - Reduces any vandalism reported in the park to provide a safe environment for families and children.
Markham Grows Seeds Library	<ul style="list-style-type: none"> - Allows members to borrow seeds at no charge. - Members replenish seeds in the library by returning seeds from the new plants they grow. 	<ul style="list-style-type: none"> - Support urban agriculture throughout the city. - Allows for people in the city to grow their own healthy affordable food.

City of Markham Energy & Environmental Management Policies		
Policy/Program	Purpose	Benefits to the City
Trees for Tomorrow	<ul style="list-style-type: none"> - 4 year strategy to increase overall tree cover in Markham - Reintroduce nature into to urban environment - GHG reduction strategy 	<ul style="list-style-type: none"> - Quality of life improvement - Proactive stance on GHG emissions - Greater erosion control - Mitigates heat island effect - Planning for future generations
District Heating and Cooling	<ul style="list-style-type: none"> - System implemented as part of urban planning initiative to increase sustainable infrastructure - District Energy plants utilize high-efficiency gas boilers, chillers, thermal storage and waste heat recovery - Electricity generated and added to grid, waste heat used for heating and cooling 	<ul style="list-style-type: none"> - Addresses the City’s goal of having a sustainable, reliable energy framework - Reduces GHG emissions - Enhances quality of life for citizens
Stormwater Management	<ul style="list-style-type: none"> - City-wide system of controlling effects of stormwater - 4 categories: flood control; erosion control; watercourse management; maintenance of stormwater management facilities - Promote systems that mimic the natural water cycle 	<ul style="list-style-type: none"> - Protect and enhance water resources - Maintain continued health of streams, lakes, fisheries and natural heritage systems - Manage risks of flood damage in natural and urban drainage systems
Milk Bags	<ul style="list-style-type: none"> - Using plastic milk bags for creating reusable plastic sleeping and surgical mats - Landfill diversion strategy - Disaster relief and humanitarian aid strategy - Heighten awareness around waste 	<ul style="list-style-type: none"> - Reduces waste: Over 2,000,000 plastic milk bags diverted from landfill since 2011 - Community building via local support groups
Smart Commute	<ul style="list-style-type: none"> - Transportation management program that offers local businesses and residents practical solutions for commuting to and from work - Supports various commute choices such as: carpooling, transit, cycling, telework and flexible work arrangements 	<ul style="list-style-type: none"> - Decreases urban traffic congestion - Improve air quality - Enhance health and well-being of community - Increase worker productivity

Table 10: Energy and Environmental Management Policies

2.3 Corporate Wide Building Automation System

In 2009, an open protocol Building Automation System (BAS) was installed across 27 major energy consuming facilities. At the same time, CIMCO series automation was rolled out to 10 community centre ice rinks to improve control of refrigeration scheduling, communication, alarming capabilities, improved operator visibility, energy consumption, and maintenance.

Measure	Cost	Savings	Length
Optimize BAS for major facilities (capital cost)	\$10,000 per building	5% per building	2015-2019



2.4 Leadership

Senior staff from the Sustainability Office, Finance, Asset Management, and Recreation recently joined forces to form a Corporate Energy Team (CET) that meet on a regular basis to discuss the City of Markham’s forefront energy management opportunities. The team is chaired by the Senior Manager of Sustainability, whom brings forth pressing issues for the team to review and draw conclusions on. The CET played a crucial role in the development and endorsement of the CEMP, acting as stakeholders for their respective internal departments. The information will then be relayed to the Demand Reduction and Energy Avoidance Management (DREAM) Team, who are responsible for implementing the changes based on the decisions from CET.

The City of Markham strives to be a leader in all merits, with Climate Change initiatives being no exception. Markham developed and published the Greenprint, a long-term Community Sustainability Plan outlining the key priorities and key performance indicators to improve sustainability in the City of Markham. At the time of its release, the Greenprint was one of the few and more aggressive sustainability documents targeted by a municipality with a target of net zero waste, water, and emissions by 2050.

The City of Markham was the first municipality in the province to participate in the Feed-In-Tariff (FIT) program, offered by the Ontario Power Authority, and to install a solar photovoltaic (PV) system. Currently, Markham has two of the largest solar arrays in York Region, and 1.4 Megawatts of total solar installed across nine City of Markham rooftops. Of the 1.4 Megawatts solar installations, Markham owns two microFIT systems, one FIT system, and leases six of its rooftops to PowerStream Solar. All new buildings owned by the City of Markham are designed and constructed to be solar PV-ready, with proper structural, mechanical, and electrical configurations to support a “plug and play” rooftop solar system.

The City has been a recognized leader in Climate Change and has received several awards for its efforts such as: the Ontario Power Authority’s 2012 Community Conservation Award (CCA), Federal Gas Tax Award, and the Partners in Climate Protection (PCP) Milestone One Award. Markham received the 2012 CCA for leadership in: creating the Markham Energy Conservation Office; Publishing the Community Sustainability Plan (the Greenprint); establishing and developing Markham District Energy as a leader in energy efficient thermal conditioning and electricity generation; the first municipality to install a solar photovoltaic system; and increasing the total installed solar up to 1.4 megawatts by 2013. The PCP Award was offered to the City for achieving Milestone 1: Creating a Greenhouse Gas emissions inventory and forecast.

Measure	Cost	Savings	Length
Form DREAM team (blended soft cost)	\$8,000	N/A	2014-2015

2.5 Past Projects and Successes

Since forming MECO in 2005, the City has already implemented a number of energy management initiatives that have greatly reduced energy consumption, maintenance, and greenhouse gas emissions at several facilities. Table 11: Facility Improvement Measures provides a high-level overview of the recently completed projects and areas that benefited from the improvements. In the past, Markham manually calculated energy savings based on best known assumptions and data. As of 2013, a meter is installed on any new project that has a cost greater than \$10,000 per year, to more easily track and report energy and cost reduction performance.

City-Wide Facility Improvement Measures (FIM)		
FIM	Locations	Completion Date
Building Envelope Improvement	8100 Warden, Markham Village Library, Thornlea Pool	June, 2010
Variable Speed Drives	8100 Warden, Thornlea School Pool, Armadale CC, Angus Glen, Civic Centre, Rouge River CC	July, 2010
Control Upgrade	8100 Warden, Markham Village Library, Armadale CC, Angus Glen CC, Civic Centre, Rouge River CC, Art Gallery	March, 2010
Pool Waste heat recovery	Angus Glen CC	July, 2010
Lighting Control and retrofit	Thornlea School Pool, Thornhill CC, Armadale CC, Civic Centre, Rouge River CC	March, 2011
Replace Standard Efficiency to Hi-Efficiency Motors	8100 Warden, Thornlea School Pool, Thornhill CC, Armadale CC	September, 2010
Boiler Plant Upgrade	Thornlea School Pool, Angus Glen CC	September, 2010
CO2 Ventilation Control	Angus Glen CC, Civic Centre	July, 2010
CIMCO Icepad Control	10 Icepads throughout the City	February, 2011
Parking Lot Lighting Retrofit	Angus Glen Parking Lot	February, 2011
De-oxygenation System for Icepad flooding	Centennial CC, Angus Glen CC, Thornhill CC, Civic Centre	February, 2011
Block Heater Controller	555 Miller	July, 2013
Energy STAR Vending Machines	City-wide	August, 2013
Exit Sign to Photoluminescent	Markham Village CC, Thornhill CC, Clatworthy CC, Milliken Mills CC, Mount Joy CC, Centennial CC	August, 2012 – April, 2014
Highbay LED Lighting Retrofit	Milliken Mills CC arena and soccer dome	September, 2013
Lighting Retrofit and Controls	Varley Art Gallery, 555 Miller	February, 2014
Refrigeration Optimization	Angus Glen CC pool refrigeration system	August, 2014
Cobra-Head Streetlighting Retrofit	City-wide	September, 2014

Table 11: Facility Improvement Measures

2.6 Energy Procurement

The City is taking action to reduce the pricing impacts by actively managing energy consumption, demand, awareness, incentive resources, and investigating procurement options. The City of Markham released a Request for Proposal and evaluated several different procurement options for all of the buildings owned by the City.

After careful consideration between fixed, variable, on-peak hedging, and contract terms, the City decided not to pursue any fixed utility procurement contracts at this time.

2.6.1 Electricity Source

PowerStream supplies the City of Markham with electricity through various rate structures, depending on building and service type. PowerStream is owned by the City of Markham, Barrie, and Vaughan. Markham and PowerStream have a strong energy partnership designed to improve energy management, with a set of clearly defined annual electricity reduction goals. PowerStream offers funding incentives for energy management in several categories such as: retrofits, monitoring and targeting, an Embedded Energy Manager, new building construction, and many more. Two of the largest incentives received from PowerStream involved retrofitting the streetlights with light-emitting-diodes (LEDs) and funding an Embedded Energy Manager. The majority of Markham's electricity consumption and billing structure is on the variable Hourly Ontario Electricity Price (HOEP) and susceptible to Global Adjustment (GA). In 2012, the Ontario Energy Board released an electricity pricing forecast report citing an increase in electricity costs by 39% to 48% from 2011 to 2016⁴. Most of the City of Markham buildings have been, and will continue to be, impacted by the electricity rate increases.

2.6.2 Natural Gas Source

Enbridge is the natural gas local distribution company for the City of Markham. Markham and Enbridge have a collaborative relationship for improving corporate and community energy management. Enbridge offers incentive funding for Markham's conservation efforts and the two companies have created a partnership to launch a Community Energy Conservation Project. Several of the incentive funds applicable to Markham pertain to upgrading less efficient boilers to high efficiency or condensing boilers, energy recovery ventilators, and condensing make-up air units.

2.6.3 Water Source

The City of Markham is supplied by drinking water from Lake Ontario purchased through the City of Toronto and Peel Region. Additionally, Markham pipes the wastewater, from its wastewater collection system, to a Pickering treatment facility where it is processed and released back into Lake Ontario. The City of Markham's water is billed through PowerStream, where both hydro and water appear on one bill per facility.

⁴ Ontario Energy Board, Ontario Electricity Price Increase Forecast December 2011 to December 2016, Bruce Sharp, 2012

2.6.4 Fleet Fuel

The large fleet vehicles used across the City are fueled by either regular unleaded gasoline, biodiesel B5, or biodiesel B20. Biodiesel is predominantly derived from vegetable oils and is a cleaner burning, renewable fuel alternative to petroleum diesel. Biodiesel B5 is comprised of 5% biodiesel and 95% petroleum diesel, with biodiesel B20 (20% biodiesel, 80% petroleum diesel) as the most common biodiesel blend in Canada and the United States. Biodiesel B20 is most popular because it balances cost, greenhouse gas emissions (GHG), cold-weather performance, materials compatibility, and does not require engine modifications. The GHG reductions are roughly proportionate to the biodiesel-to-petroleum diesel blend level: a biodiesel B20 (20% biodiesel, 80% petroleum diesel) would have roughly a 20% reduction in GHG emissions. The relative emissions between diesel and biodiesel can be viewed in Figure 18: Diesel and Biodiesel Emissions Comparison. The City of Markham is considering the use of natural gas in its fleet vehicles.

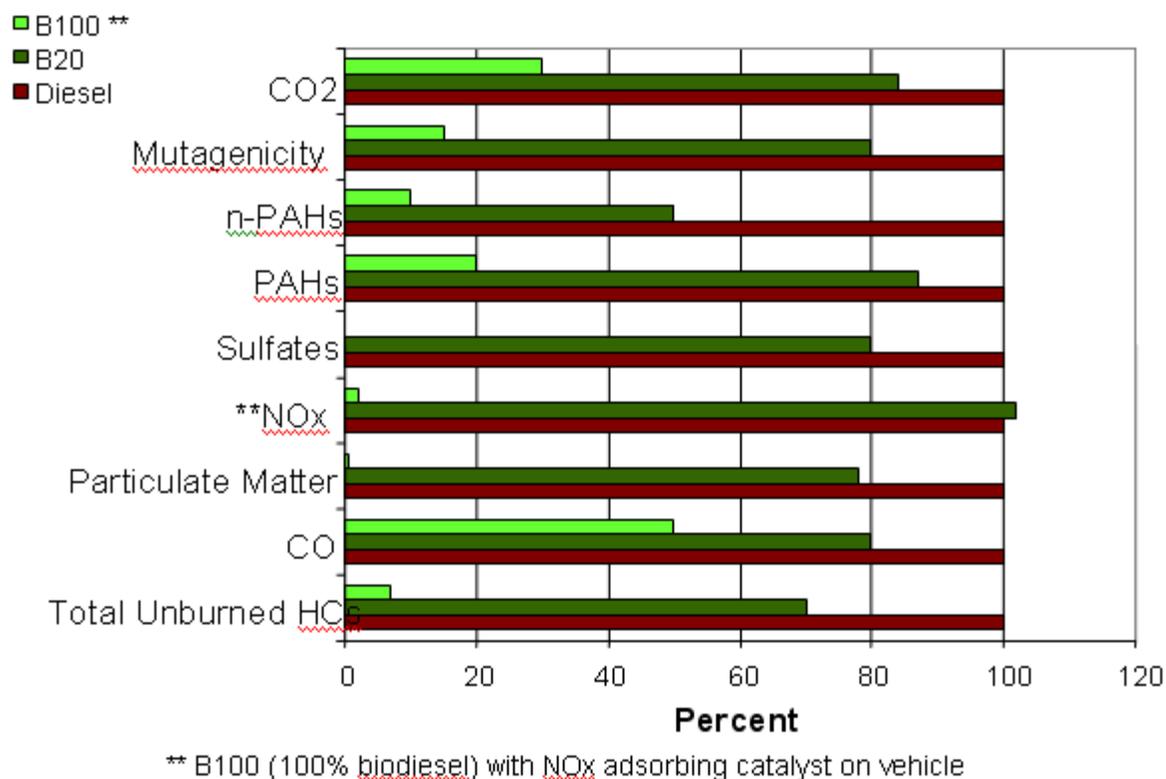


Figure 18: Diesel and Biodiesel Emissions Comparison⁵

The zamboni machines that act as ice resurfacers for the indoor and outdoor ice rinks use propane as its fuel source. Propane is a cleaner burning fuel that can be removed from the atmosphere by precipitation or natural oxidation, which reduces its impact on climate change. Figure 19: End-Use Carbon Dioxide Emissions by Fuel illustrates propane’s emissions effects relative to other common fuel sources.

⁵ Biotechx Energy International Ltd, CO₂ Emission Comparison, 2014

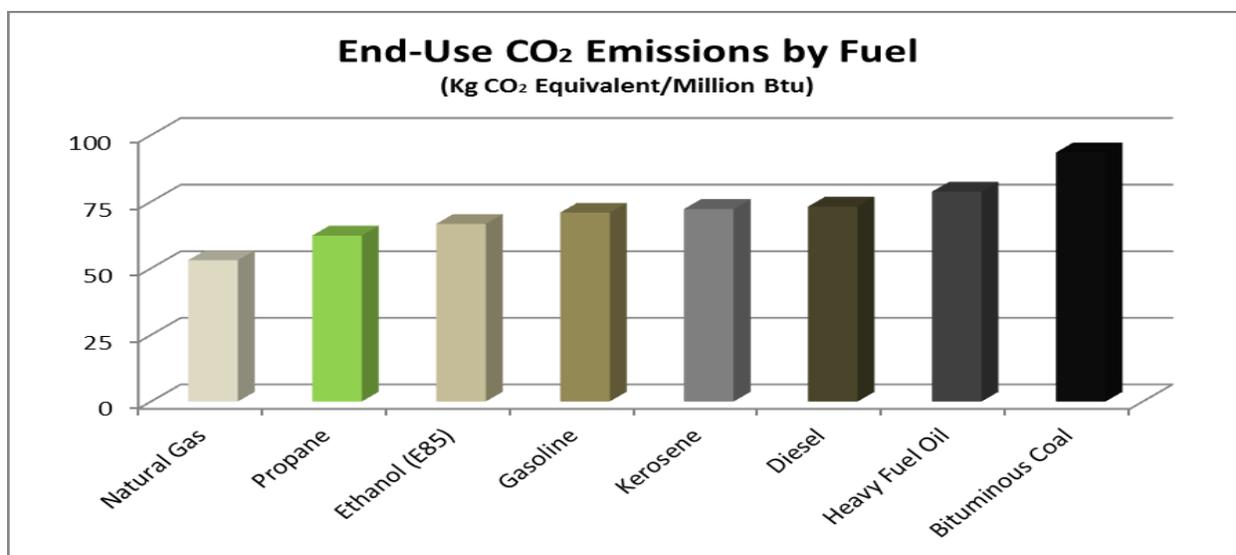


Figure 19: End-Use Carbon Dioxide Emissions by Fuel ⁶

2.6.5 District Heating and Cooling Source

Markham District Energy Incorporated (MDEI) is a district energy system wholly owned by the City of Markham. MDEI supplies heated and chilled water via a piping system in the ground to public and private facilities in Markham and Cornell centres, and are continually expanding to meet the needs of growing demand, while also supplying electricity to the grid as needed. Using a centralized heating and cooling system is comparably more efficient than installing custom heating and cooling systems in the facilities because MDEI can purchase, maintain, and operate larger equipment, which is typically more efficient than installing several smaller units. MDEI owns and operates four combined heat and power (CHP) units that recover waste heat which is used in the system, and generates electricity for the local grid and for back-up power needs. MDEI is EcoLogo Certified and has received an award for Donald Cousens Conservation and Environmental Leadership. The City of Markham was awarded the Association of Municipalities of Ontario (AMO) Federal Gas Tax Award for investing in a more efficient and economic fuel source, MDEI. The City evaluates and targets all new construction buildings in the MDEI zones for district energy.

Measure	Cost	Savings	Length
Evaluate Procurement Contracts (EEM soft cost)	\$5,000	TBD	2014-2019
Expand MDEI to buildings where feasible (DC/tax cost)	Cost neutral	5% to 15% energy per building	2014-2019

⁶ Canadian Propane Association, Emissions by Fuel Comparison, 2014

3 Goals, Objectives, Measures of Performance, and Targets

The City of Markham’s Corporate Energy Management Plan (CEMP) has three goals:

4. To position the City to move toward the Greenprint’s goal of “net zero energy, water, waste and emissions by 2050”.
5. To support the Corporate Goal of a “Safe and Sustainable Community” where “We will protect the public and respect the natural and built environments through excellence in sustainable community planning, infrastructure management, and programs.”
6. Develop a Corporate Energy Management Plan that meets the requirements for O.Reg 397/11: Energy Conservation and Demand Management Plans and Partners in Climate Protection Milestone’s Two and Three.

To achieve our goals we developed the following objectives outlined in Table 12: CEMP Objectives.

City of Markham CEMP Objectives
Manage energy consumption, energy demand, and greenhouse gas emissions
Manage direct and indirect operating costs
Increase equipment reliability and occupancy comfort
Demonstrate leadership in renewable energy and efficient fuel sources
Enhance the existing culture of energy management and sustainability

Table 12: CEMP Objectives

The City of Markham achieved Partners in Climate Protection (PCP) Milestone 1 by creating a greenhouse gas inventory and projecting future emissions. Council endorsement of the CEMP should allow the City of Markham to achieve Corporate Milestone 2 and 3 by setting municipal operations emissions reduction targets (defined in Table 13: CEMP Performance Measures and Targets), and developing an action plan to achieve those targets as outlined in the CEMP.

The baseline year in the CEMP was selected as the last full year with complete energy data, 2012. The baseline, which the objectives are based off of, is illustrated in Table 14: Baseline Energy Consumption Summary.

City of Markham CEMP Performance Measures	Target by 2019
Corporate facility total energy intensity (ekWh/ft²/yr)	10% Reduction
Corporate facility peak electricity demand intensity (W/ft²/year)	10% Reduction
Streetlighting energy intensity (kWh/fixture/year)	20% Reduction
Municipal operations greenhouse gas emissions intensity (kg GHG/capita/year)	5% Reduction

Table 13: CEMP Performance Measures and Targets

City of Markham Performance Measure Baseline and Targets Quantified				
Baseline Description	Energy	Unit	Base	Target
Corporate facility total energy intensity	51,080,885 kWh/year	1,449,072 ft ²	35.25 kWh/ft ² /year	31.73 kWh/ft ² /year
Corporate facility peak electricity demand intensity	7,223.3 peak kW/year	1,177,118 ft ²	5.55 W/ft ² /year	5.00 W/ft ² /year
Streetlighting energy intensity	17,644,048 kWh/year	24,699 fixtures	714.35 kWh/fixture/year	571.48 kWh/fixture/year
Municipal operations greenhouse gas emissions intensity	10,914,929 kg GHG/year	310,000 capita	35.21 kg GHG/capita/year	33.45 kg GHG/capita/year

Table 14: Baseline Energy Consumption Summary

The CEMP objectives were selected based on: energy and demand reduction commitments to the Ontario Power Authority through the Embedded Energy Manager program; the PCP Milestones 2 and 3 requirements, the Greenprint’s net-zero waste, waste, and emissions by 2050 goal; the new corporate Business Plan, and areas where the City of Markham believes it would most benefit from improvements.

4 Monitoring and Verification

The City of Markham created a basic measurement and verification (M&V) strategy for energy conservation projects and operational management that closely follows the International Performance Measurement and Verification Protocol. The size, scale, and complexity of the projects dictate which M&V process the City pursues.

4.1 Project Metering

The City installs an electrical meter on any energy retrofit project that has a total cost greater than \$10,000, for the purpose of tracking energy performance. This simplifies the M&V as well as the reporting process for energy conservation measures. Meters were installed on the following projects: block heating at 555 Miller (2013), lighting retrofits at Milliken Mills CC (2013), refrigeration optimization system at Angus Glen CC (2014), and the lighting retrofit at 555 Miller (2014).

Measure	Cost	Savings	Length
Add additional project meters (capital cost)	\$3,000 per project	1% to 3% per project	2014-2019

4.2 Sub-Metering

On most new large buildings, such as recreation complexes, the City installs a sub-metering system to improve its understanding on when and how the energy is being used inside the facility. To date, buildings with an advanced sub-metering system include: the Civic Centre (2012) and Cornell Community Centre (2013). Although the systems are very useful when an experienced individual is working with them, the City of Markham currently has limited resources to adequately monitor and manage energy consumption with these powerful tools.

Measure	Cost	Savings	Length
Investigate centralizing sub-metering monitoring and management (capital cost)	\$10,000 to \$20,000 for study	10% per building	2015
Centralize sub-metering monitoring and management at largest facilities (capital cost)	\$0.1/sq ft	5% to 10% per building	2016-2019

4.3 Financial Data

Financial data is used in the absence of a sub-metering system or project specific meters. Monthly financial data can perform rough monitoring and verification for the building. Monthly financial data is typically used for building operational savings projects when a sub-metering system does not exist and installing meters to track savings is cost prohibitive. Large buildings are more difficult to verify savings relative to small buildings.

4.4 PowerStream Interval Metering

Interval, or hourly, metering is a valuable tool to analyze energy consumption at various points in the day and week. Interval metering can assist in identifying and differentiating where the largest opportunities for improvements are available. Hourly meters assist in determining load factor, peak demand, occupied versus unoccupied consumption, holiday consumption, and if the systems operate according to their programmed scheduling. PowerStream provides a whole building electricity interval meter for facilities with a demand of at least 200 kW. The buildings that currently have an electricity interval meter installed through PowerStream are: Angus Glen CC, 6140-16th street, Centennial CC, Markham Theatre, Thornhill CC, Civic Centre, 2400 John Street, Milliken Mills CC, and Enterprise Drive. Additionally, Markham requested interval meters and access for these facilities that also meet PowerStream’s criteria: Crosby CC, 14th Pumping Station, and Markham Public Library. The City of Markham is able to view hourly data through PowerStream’s web-based application, Powerview. MECO gained access to Powerview’s meter data in October, 2012.

Measure	Cost	Savings	Length
Increase quantity of buildings with PowerStream Interval Metering (capital cost)	\$500 per building	N/A	2014-2015
Provide facility staff with Powerview training and login information (blended soft cost)	\$1,500 per session	N/A	2015-2017

5 Energy Communication Plan

The City of Markham is adding more focus to their energy awareness program to further promote energy conservation and efficiency. With the planned awareness program comes a suggestion program, online energy awareness program for additional information, operator recommendations that can be shared across facilities, and integration into the life cycle process. The suggestion program will be created to encourage staff to incorporate energy conservation into their work routine, and recognize them for innovative ideas for energy improvement. The City has found that suggestion programs add a positive attitude to the program and increase participation. By creating meetings for targeted groups, Markham was able to build off of best practices through common facilities and gain important knowledge on the benefits of each energy efficiency measure. Additionally, MECO promotes important energy issues and information sessions through live Lunch and Learns. Energy savings from awareness initiatives cannot be measured per say but could be calculated based on assumptions from observable behaviour changes. Furthermore, MECO intends on working with Human Resources to add energy awareness into the on-boarding training. The sections below outline the key tactics MECO is utilizing to improve energy communication and awareness.

5.1 Energy Skills Training

In 2013, Markham and Natural Resources Canada (NRCan) teamed together to produce a customized energy management workshop for City of Markham staff. Two facilitators utilized a variety of physical demonstrations, calculation worksheets, graphic slides, case studies, and discussions to create a highly effective learning environment. The workshop featured discussions regarding: reading and analysing electricity bills, calculating energy usage, spotting and reporting energy savings opportunities, calculating energy savings, energy projects from past to present in the City of Markham, benchmarking facilities, the Green Energy Act's Ontario Regulation 397/11 plan development, and re-commissioning. The workshop was supported by funding from NRCan and MECO.

One of the reoccurring suggestions from facility supervisors and operators was to offer Building Automation System (BAS) training and attend in-depth energy management courses to expand on their system and energy management knowledge. Markham is in conversations with the BAS providers to implement BAS training on their own systems that will allow staff to better understand and manage the BAS inside their facility. Additionally, Markham is considering the option of including energy management targets in employee performance reviews and recognizing outperforming staff for their success in achieving the targets.

Measure	Cost	Savings	Length
BAS training from BAS providers (capital/blended soft cost)	\$1,000 per session + \$1,500 per session	1% to 3% per year	2015-2016
Building Operator Energy Management Course (capital/blended soft cost)	\$1,500 per person + \$250 per person	1% per year	2015, 2019
Evaluate including energy targets in staff performance reviews (DC/tax cost)	\$2,000 per person	1% to 3% per year	2015-2019

5.2 Energy Management Information System

The Energy Management Information System (EMIS) that the City of Markham is interested in is a web-based tool to streamline energy information supplied to all key stakeholders, manage energy usage, and manage energy costs. The introduction and assimilation of an EMIS into Markham’s energy management system has cross-commission benefits including: providing timely and practical energy information to building managers and supervisors, auditing historical operations and bills, energy project tracking, budgeting comparisons to actual consumption and cost, benchmarking similar facilities, best practice development, cost avoidances due to early detection, faulty meter discovery, and improved occupant habits.

Markham created a two-phased preliminary approach to the EMIS. In the first phase, the City created a Request for Proposal to incorporate the 50 highest energy consuming buildings into an EMIS. The proposal encompassed the top 50 building’s electric, water, and gas meter billing data into an EMIS with a collection of minimum requirements.

In the second phase, Markham intends to work with PowerStream to have interval meters installed on all buildings above 200 kW demand. The EMIS will expand monthly data tracking to remaining buildings above 100 kW and to all interval meters.

Portfolio Manager is a free online tool, developed by the Environmental Protection Agency, to measure and track energy and water consumption, benchmark similar buildings against the industry averages, and calculate greenhouse gas emissions. The EMIS is set up to automatically upload the City of Markham data to Portfolio Manager. The City will review its progress in energy efficiency against similar buildings across Canada and the US.

Measure	Cost	Savings	Length
Enter building data into Portfolio Manager (EEM soft cost)	\$500 per year	N/A	2014-2019
Establish an EMIS (capital cost)	\$5,500	N/A	2014
Provide facility staff with EMIS training (blended soft cost)	\$2,000	N/A	2015
Use EMIS in conjunction with project and sub-meters to track energy performance (capital/EEM soft cost)	\$4,600 per year capital + \$1,000 soft cost	0.2% to 0.5% per year	2014-2015

5.3 Lifecycle

MECO is working with Asset Management and Recreation to leverage the lifecycle process in upgrading to more energy efficient equipment when the components are at the end of its lifecycle. Typically, the equipment would be replaced with a new model of equivalent value available on the market. Asset Management and facility supervisors are challenged to investigate more energy efficient equipment with financial support from MECO, available government energy incentives, engineering studies, qualified vendor and engineering firm recommendations, and/or information support from MECO.

Measure	Cost	Savings	Length
Support lifecycle upgrades with funding, incentives, and studies (capital/ blended soft cost)	\$100,000 to \$175,000 per year	5% to 20% on new equipment	2014-2019

5.4 Special Events

Special events focused on sustainability and/or energy that is well advertised is another effective method of communicating energy conservation and raising the energy management culture. In advance of all major energy events, the event is advertised through the use of posters, articles, flyers, and emails on how the City is participating, how the community can participate, and the benefits surrounding the event. During Earth Hour, the City of Markham turned off auxiliary equipment and referenced the posters prepared and distributed throughout the City’s public bulletin boards as to why the City stands behind the initiative. Markham also hosted a Green Energy Doors Open Tour at the Markham Civic Centre to showcase all of the energy conservation and renewable energy generation measures taking place at the City. The tour related all of the initiatives back to how the community could participate in similar measures.

Measure	Cost	Savings	Length
Support additional special events to promote energy awareness (capital/EEM soft cost)	\$1,000 per event + \$1,000 per event	N/A	2014-2019

5.5 Projects

The teams involved in completing energy projects gained valuable knowledge and lessons learned that are shared in the organization. Project successes are communicated through electronic news articles, on the MECO webpage, with posters around the complex, and during energy meetings. Successful projects can lead to best practices, behaviour change, idea generation and development, confidence in the programs, and improvement suggests.

Measure	Cost	Savings	Length
Integrate into the monthly building manager forum to share best practices (blended soft cost)	0.2% per staff salary involved	0.2% per year	2014-2019



5.6 Webpage Awareness and Resources

In an effort to promote energy awareness, an online campaign was established with several useful tips and links. The focus was on a blend of work and home conservation material to improve energy conservation and efficiency in everyday life. Some key elements were: conservation tips for the home and office, Watt Reader library rental information, the Small Business Lighting program, SaveONenergy incentives for business and home, recently completed energy projects throughout the City, the CEMP, and a frequently updated stream of energy efficiency news. The motivation behind home conservation is that if individuals conserve at home then it will become instinctual and natural to conserve in the workplace. At this time, the webpages are not used to their full potential and most staff are not aware of the resources available to them.

Measure	Cost	Savings	Length
Increase webpage awareness (blended soft cost)	1% per staff salary	0.5% per year	2014-2019

5.7 Monthly Building Summary

The Corporate Energy Team is collaborating to develop an Energy Management Information System (EMIS) that produces a monthly energy performance summary based on input from the Demand Reduction and Energy Avoidance Management (DREAM) team. The facility operating staff were interested in viewing data relating to year-over-year energy and cost comparisons, energy and cost relative to budgets, and benchmarking performance with competitions by facility type. Using an EMIS, the DREAM team will be better able to manage their utility consumption and costs.

Measure	Cost	Savings	Length
Establish competition by facility type (blended soft cost)	\$3,000 per event	0.1% per event	2014-2019

5.8 Regulatory and Internal Reporting

Regular reporting is a beneficial method of notifying all key stakeholders of on-going initiatives and successes, as well as providing stakeholders with forums that encourage engagement and knowledge exchange. Table 13: Regulatory and Internal Reporting is a summary of the regulatory and internal reporting the City of Markham is guided by.

Regulatory and Internal Reporting	
Reporting Item	Timeline
Embedded Energy Manager's Energy Management Plan (PowerStream)	April 2013, Annually thereafter
Ontario Regulation 397/11: Energy Consumption and GHG Emissions Summary	July 2013, Annually thereafter
Ontario Regulation 397/11: Energy Conservation and Demand Management Plan	July 2014, Every 5 Years thereafter
Corporate Energy Team	Bi-weekly or Monthly
Executive Leadership Team (ELT)	Quarterly
Facility Operation Staff	Monthly
Partners in Climate Protection Milestone 2	TBD
Partners in Climate Protection Milestone 3	TBD
Council Update Reports	Annually

Table 14: Regulatory and Internal Reporting

Measure	Cost	Savings	Length
Create energy management plans for reporting (blended soft cost)	\$6,000 + \$1,000	N/A	2014
Externally report annually on energy consumption and GHG emissions (EEM soft cost)	\$2,000	N/A	2014-2019
Internally report on energy consumption and costs (blended soft cost)	\$2,000 to \$5,000 per year	N/A	2014-2019

6 Operational Best Practices

Improving operational efficiency is an effective method of improving energy management and is typically a no or low cost approach. When building owners obtain organized and concise data on their building’s operation and performance, they gain the necessary tools and understanding of what opportunities are most beneficial to pursue.

Asset Management is responsible for updating and managing facility documentation pertinent to facility operation and maintenance such as drawings, automation systems, manuals, warranty letters, and maintenance contracts. In 2013, Asset Management undertook a detailed project to organize its filing structure and collect all available documentation. Through this exercise, it was evident that the City does not have complete records of every facility. Asset Management developed a project hand-over procedure which requires all facility documentation at project completion. This procedure need to be rolled out to all Facility Staff. Implementation of a full record keeping system will assist with future projects.

Measure	Cost	Savings	Length
Roll out Project Hand Over Procedure to Facility Staff (soft cost)	5% per staff salary	N/A	2016
Work with facility staff to retrieve all new building documentation (soft cost)	0.1% per staff salary	N/A	2014-2019

6.1 Incorporate in Operating Procedures

Energy management plays a crucial role in cost avoidance, and often goes hand-in-hand with best practice operating procedures. Operating the equipment more efficiently is normally directly proportional to prolonged equipment life due to reduced operating hours, reduced operating speeds, reduced heat generation on mechanical and/or electrical equipment, improved control schemes, and reduced loads on equipment. In Markham’s experience, there has been a strong correlation between reduced energy and maintenance costs upon completing energy management projects.

Measure	Cost	Savings	Length
Study best practice operating procedures for major equipment (capital cost)	\$10,000 to \$15,000 per building type	N/A	2016
Implement best practice operating procedures for major equipment (blended soft cost)	\$5,000 to \$10,000 per building type	1% per year	2017-2019

6.2 Re-Commissioning and Energy Audits

Re-commissioning, or retro-commissioning, is a cost-effective process to optimize existing building performance and identify operational improvements to: increase occupant comfort, reduce maintenance, extend the life of building equipment, increase operator knowledge on building operation, and reduce energy costs.

Building priority was sorted based on the following criteria:

- Largest Energy Use Index (EUI)
- Persistent equipment and/or control system issues
- Unexplained increase in energy consumption
- Occupant comfort complaints

Re-commissioning is important in any business due to the fact that: occupant variances may require different buildings system functions, opportunities to improve comfort and performance increase as buildings age, building automation systems are growing increasingly complex and difficult to manage. Typical payback periods for existing building re-commissioning are between 0.2 to 2.4 years⁷.

The City of Markham partnered with Humber College to mutually benefit in undertaking energy audits at the top consuming facilities in the City of Markham. By partnering with Humber College, the students have an opportunity to use the skills and knowledge they've gained through the course of their education, and apply it in their Capstone projects to identify and recommend measures that will aid in reducing energy consumption at municipal facilities.

Markham benefits from energy audits by:

- Reduced energy consumption and cost
- Identified equipment and operational opportunities for improvement
- Major equipment inventory lists generated by the students
- Energy data benchmarked and analyzed

Measure	Cost	Savings	Length
Re-commission buildings as necessary (capital/blended soft cost)	\$0.15 to \$0.30 per ft ²	5% to 20% per facility	2016-2019
Partner with Humber College to perform energy audits in lowest performing facilities (blended soft cost)	\$1,000 per building	1% per building	2014-2019

⁷ Evan Mills, Ph.D., Department of Energy, Building Commissioning

6.3 Demand Response

Demand Response (DR) is a program available through the Ontario Power Authority (OPA) that enables companies with large energy consumption and demand to reduce their load during a peak demand event in Ontario. Peak demand response events occur just a few times a year, so peaking power plant assets run at a fraction of their capacity most of the time during the year. DR is a way for utilities to reduce the need for large capital expenditures, and thus keep electricity rates lower overall. Instead of adding more generation capacity to the system, Utilities pay energy users to reduce demand because it is cheaper and easier to procure. DR events occur all year around during weekdays that do not fall on holidays. The City currently has the Markham Civic Centre and Thornhill Community Centre enrolled, with intent to include other recreational facilities that have year-round ice rinks, buildings with natural gas generation, and potentially pumping stations.

The City of Markham is evaluating constructing new corporate buildings with natural gas backup generators as opposed to what the City typically installs; diesel backup generators. Natural gas generators are capable of participating in DR, and release fewer greenhouse gas emissions. The City is also investigating using natural gas generators as full backup power at strategically selected facilities for use as an Emergency Operation Reception.

Measure	Cost	Savings	Length
Increase DR participation where feasible (blended soft cost)	\$5,000 per building	\$75/kW enrolled	2014-2019
Evaluate natural gas rather than diesel backup generation in new buildings (blended soft cost)	5% cost per building	\$75/kW enrolled	2015-2019

7 New Construction

The City of Markham is evaluating the most feasible options to achieve net-zero in energy, water, waste, and emissions by 2050. New City of Markham buildings constructed for a growing population will result in; increase energy consumption, water, waste and GHG emissions in the City. To minimize the impact from buildings in energy consumption, water consumption, waste and emissions the City of Markham will design and construct energy efficient buildings that are solar-ready and will take advantage of MDEI where possible.

As of January 1st, 2012, new construction projects must follow compliance with the energy efficiency requirements referenced in the Ontario Building Code (SB-10 July 1st, 2011). Table 14: Ontario Building Code Compliance Requirements defines the criteria to comply with the updated Ontario Building code with respect to energy efficiency.

Ontario Building Code Compliance Requirements:		
Compliance Path	-OR-	-OR-
Exceed the energy efficiency level of the 1997 Model National Energy Code for Buildings by 25%	Exceed ASHRAE 90.1-2010 by 5%	Meet the prescribed modifications to ASHRAE 90.1 that are set out in the SB-10

Table 15: Ontario Building Code Compliance Requirements

7.1 LEED Silver Certification

The term LEED is an acronym for Leadership in Energy & Environmental Design. It is a voluntary sustainability rating system that evaluates and represents environmental and energy performance for the entire building over the building’s lifecycle. LEED provides a comprehensive list of Canadian building standard guidelines to improve building performance, which falls into in six categories with associated credits: Material and Resources, Innovation & Design Process, Water Efficiency, Energy and Atmosphere, Indoor Environmental Quality, and Sustainable Sites. York Region’s New Construction Policy, Sustainable Development Through LEED, was adopted at the City of Markham and requires a minimum of LEED Silver rating for all new corporate facilities and major renovations.

Buildings that are built to the LEED Silver standard in the City will provide less of an impact on the environment. This will result in efficient use of energy, water and materials including better indoor air quality and reduced emissions over the life of the building. The energy avoidance is determined from comparing how much energy the buildings would use by designing to the National Energy Code for Buildings versus how much energy the buildings would use when designed to LEED Silver (or better). The registered for LEED Certification City of Markham buildings are outlined in Table 15: City of Markham LEED Buildings with the verified and desired certification levels.

City of Markham LEED Buildings		
Building Name	Certification Level	Certification Date
Markham Museum Collections Building	Gold	2014-03-06
Markham Fire Station 93	Gold	TBD
Cornell Community Centre & Library	Silver	2014-02-10
Markham Fire Station 99	Silver	2014-02-04
Markham Pan Am Centre	Silver Target	TBD
South East Markham Community Centre and Library	Gold Target	TBD

Table 16: City of Markham LEED Buildings

Measure	Cost	Savings	Length
Design all new buildings with at minimum LEED™ Silver (DC/tax cost)	2% to 5% per building	25% to 40% per building	2014-2019

7.2 High Performance New Construction

The City of Markham is investigating and pursuing all avenues available to construct sustainable buildings with high environmental and energy management standards. The High Performance New Construction (HPNC) program offered through the Ontario Power Authority’s saveONenergy program is one such avenue that offers the City with incentives and design assistance. The HPNC program offers to fund 100% (up to \$10,000) of the cost to model a new building with options to receive incentives on energy efficient equipment through the prescriptive, engineered, or custom approaches. To date, the City of Markham has filed applications to receive HPNC incentives on the Cornell Community Centre, the Pan Am Community Centre, and the South East Markham Community Centre and Library. The energy consumption and cost avoidances are tied with decisions made in the LEED Silver certification.

Measure	Cost	Savings	Length
Evaluate and Apply for HPNC incentives on new construction buildings where feasible (soft cost)	\$5,000 per building	\$400/kW or \$0.05/kWh for lighting \$800/kW or \$0.10/kWh non-lighting	2014-2019

8 Renewable Energy

The City of Markham puts a strong emphasis on renewable energy and is open to experimenting with new technology that is environmentally sustainable and proves to have a good return on investment. One of the Greenprint’s goals is to achieve net-zero energy, waste, water, and emissions by 2050. Renewable energy expansion plays a crucial role in generating enough energy capacity to balance the City’s annual energy consumption and demand, thus accomplishing the net-zero targets.

8.1 Solar Photovoltaic

All new corporate buildings constructed by the City of Markham are designed and constructed as solar-ready, with proper structural, mechanical, and electrical configurations to support a rooftop solar system. Markham’s Solar Projects (Table 16: City of Markham Installed Solar Projects) generate approximately \$300,000 of non-tax revenue for the City, assisting to counteract the City’s utility costs. The solar projects generate 1,514,654 kWh per year of clean renewable energy, offsetting nearly 120 tonnes of GHG’s. Markham also applied for solar projects through the FIT program on some of the newly constructed facilities, and intends to continue adding solar installations with good return on investments for the foreseeable future.

City of Markham Installed Solar Projects		
Property Description	Project Type	Annual Production (kWh/year)
Mount Joy Community Centre	Lease to PowerStream Solar	327,000
Angus Glen Community Centre	Lease to PowerStream Solar	272,500
Milliken Mills Community Centre	Lease to PowerStream Solar	109,000
Clatworthy Community Centre	Lease to PowerStream Solar	130,800
Thornhill Community Centre	Lease to PowerStream Solar	381,500
Markham Civic Centre	microFIT	10,454
Fire Station 99	microFIT	10,900
8100 Warden	FIT	272,500
	Total	1,514,654

Table 17: City of Markham Installed Solar Projects

Measure	Cost	Revenue	Length
Install solar systems where feasible (soft cost)	TBD	TBD	2014-2019
Lease rooftop to PowerStream where feasible (soft cost)	TBD	TBD	2014-2019

8.2 Solar Thermal

In 2007, an 18 collector seasonal solar thermal pool heating system with waste heat recovery was installed at Milliken Mills Community Centre. In 2010 a similar, but larger, 24 collector seasonal solar thermal and waste heat recovery system was installed at Centennial Community Centre. The City would be interested in adding additional solar thermal projects with short return on investments.

8.3 Ground Source Heating and Cooling

The City has two Ground Source Heating and Cooling (GSHC) Systems installed: one supplies thermal energy to Fire Station 93 and the other to the Museum Collections Building. Fire Station 93's system was installed in 2010, and the facility has seen an energy reduction of approximately 64%. The Museum's system is similar in size to Fire Station 93's but there is insufficient utility data available to analyse the savings at this facility. As a result of longer payback terms from rising electricity prices and low natural gas prices, the City is not actively pursuing additional GSHC systems.

Measure	Cost	Savings	Length
Expand renewable energy initiatives where feasible (soft cost)	Varies depending on energy source	Varies depending on energy source	2014-2019

9 Financial Considerations

For 2013 and 2014, Gas Tax Funding from an approved Capital Project list was the backbone of energy management projects. The City is seeking alternatives to reduce its dependency on Gas Tax Funding for energy management, which would lower its risk of not receiving funding against other competing projects. See Table 17: CEMP Measures - Estimated Costs and Savings by Year for annual overview and Appendix B for detailed description of projects, forecasted costs, and savings. Table 17: CEMP Measures - Estimated Costs and Savings by Year outlines the expected expenditure in order to save the estimated cumulative annual savings against the baseline. **All of the savings accumulated by each measure will carry over into subsequent years. Without the capital funding and staffing resources recommended throughout the CEMP, the City of Markham may have difficulty achieving its objectives and targets.**

The preliminary cost and savings estimates were based on the prioritization of several projects planned for the duration of the CEMP. The projects were prioritized according to return on investment, lifecycle, low risk/ease of implementation, repeatability, and resolving persistent issues. The CEMP outlines estimated staffing resources over the next 5 years; new staffing costs were not included in the CEMP since all staffing costs implied in the plan are with existing resources. The Energy Retrofit Capital category will follow the City of Markham’s procedures of requesting projects through the annual capital budget process.

City of Markham Recommended CEMP Energy Retrofit Measures by Year							
Type of Measure	2014	2015	2016	2017	2018	2019	5 Year Total
Energy Retrofit - Capital Budget ¹	132,500	169,100	210,100	187,600	209,100	186,600	1,095,000
Energy Retrofit - EEM Staff Soft Cost ²	52,000	53,500	57,500	67,500	74,500	72,000	377,000
Energy Retrofit - City Staff Soft Cost ³	22,200	26,700	18,600	34,700	34,100	38,700	175,000
Energy Retrofit - Total Cost	206,700	249,300	286,200	289,800	317,700	297,300	1,647,000
Energy Retrofit - Estimated Savings	61,850	148,450	271,050	391,400	519,625	634,350	2,026,725

Table 18: CEMP Measures - Estimated Costs and Savings by Year

¹ Capital Budget costs to fund energy retrofits and best practices with attractive paybacks

² Staffing/soft costs of embedded energy manager (EEM) to implement best practices with attractive paybacks. The EEM is an existing member of staff and not a new financial request

³ Staffing/soft costs of City staff to assist in implementing best practices with attractive paybacks. The staff costs are existing costs and not a new financial request

The energy retrofit measures were divided by funding resource categories but should be considered as components of the same mechanism to implement each measure. The capital and staffing resources are equally essential in coordinating the successful completion of the projects and energy reductions. The analysis of new construction and major renovations to existing buildings were excluded from the summary tables due to variability of building construction. The benefits and costs of energy efficiency measures to the City will be evaluated as new buildings are added to the City’s portfolio. Likewise, renewable energy additions are variable and will be evaluated as opportunities arise.

9.1 Energy Conservation Fund

The City of Markham is in preliminary stages of studying a revolving energy conservation fund (ECF). The premise is to provide sufficient funding (from renewable energy, grants, utility rebates, approved capital projects, Demand Response, and confirmed energy savings from projects) to finance all energy management projects with return-on-investments of 5 years or better. The only cost associated with the fund is the salary costs associated with establishing and managing the ECF.

By the end of 2015 Markham is endeavouring to develop and endorse a self-funding financial model that re-invests renewable energy revenues, incentives, grants and energy savings to fund energy management staff resources and new energy projects.

Measure	Cost	Savings	Length
Establish the ECF (blended soft cost)	\$2,000 to \$5,000	N/A	2015
Utilize the ECF to fund energy projects (blended soft cost)	\$1,000 per year	N/A	2015-2019

10 Conclusion

The recommended measures defined in the Corporate Energy Management Plan (CEMP) were developed based on the best available knowledge at the time of creation. Several of the measures are low cost with potentially large opportunities for energy, greenhouse gas emissions, and cost avoidance. The CEMP is intended to act as a framework to address the increasing concerns with respect to managing energy consumption, demand, cost, and greenhouse gas emissions. With rising fuel prices, aging energy infrastructure, finite fuel resources, and speculation on global warming, energy management is becoming increasingly important for not only municipalities but the world as a whole.

If followed as a guiding tool, the plan will assist the City of Markham in achieving the goals presented in the plan, as well as satisfy the requirements for Ontario Regulation 397/11: Energy Conservation and Demand Management Plans and the Partners in Climate Protection Corporate Milestone 2 and 3.

Appendix A: CEMP Self-Assessment Tool

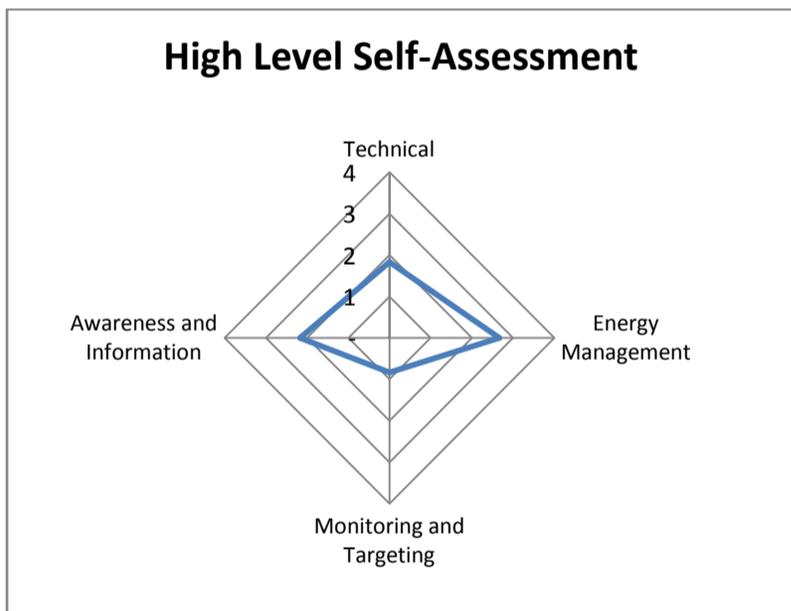
The City of Markham undertook a Natural Resources Canada self-assessment tool to determine its strengths, weaknesses, and opportunity for improvement. Each section was graded on a scale from 0 to 4, with zero representing a generous opportunity for growth and 4 representing next to zero room for growth.

There were four major categories the City reviewed:

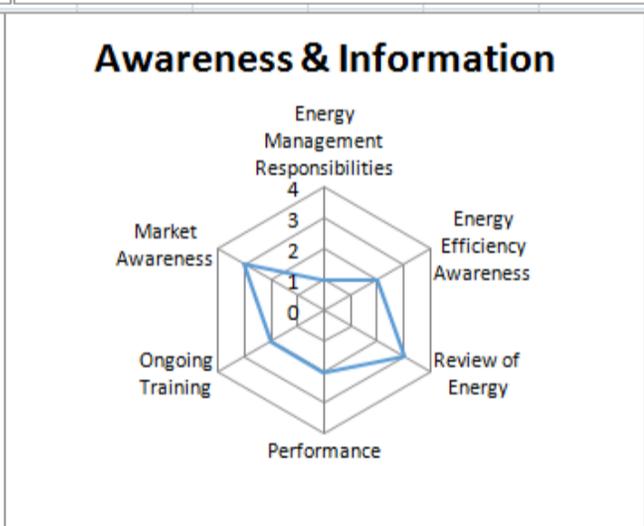
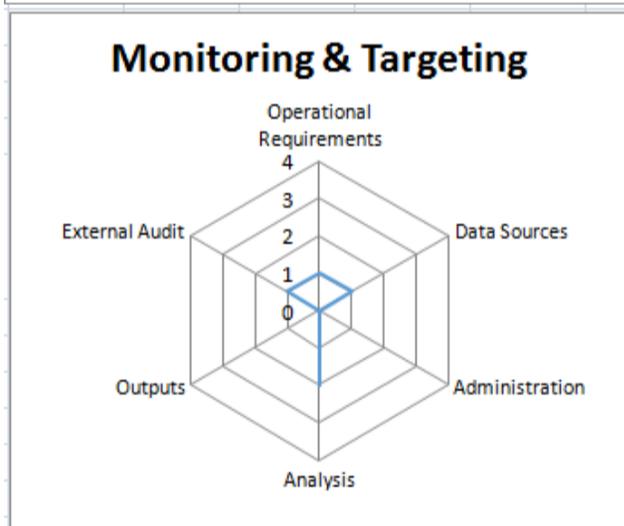
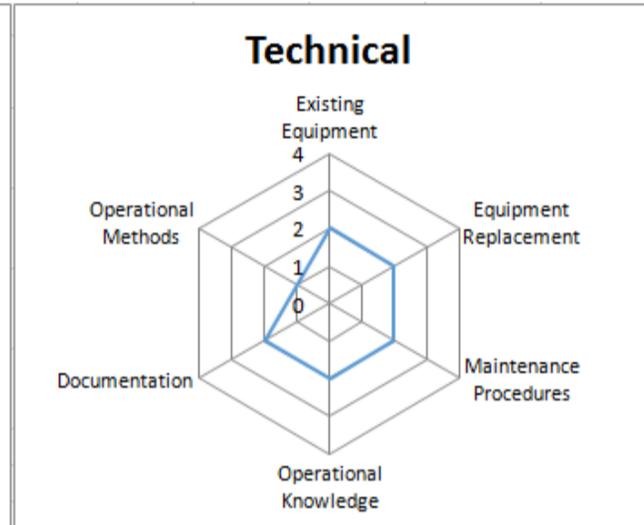
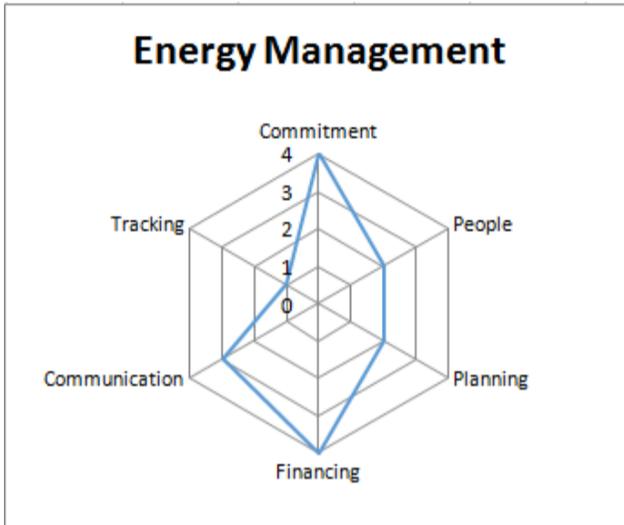
1. Energy Management,
2. Technical,
3. Monitoring & Targeting, and
4. Awareness & Information.

In each category, there were six areas of focus that granularly evaluated the greatest room for improvement within the high-level category. Markham found that its greatest areas for improvement were in the Technical and Monitoring & Targeting categories. The CEMP intends to build on all categories while focusing on the categories with the greatest opportunities for improvement.

Description	Average Ranking
Energy Management	2.67
Technical	1.83
Monitoring and Targeting	0.83
Awareness and Information	2.17



High-Level Assessment	Commitment	People	Planning	Financing	Communication	Tracking	Average
Energy Management	4	2	2	4	3	1	2.67
High-Level Assessment	Existing Equipment	Equipment Replacement	Maintenance Procedures	Operational Knowledge	Documentation	Operational Methods	Average
Technical	2	2	2	2	2	1	1.83
High-Level Assessment	Operational Requirements	Data Sources	Administration	Analysis	Outputs	External Audit	Average
Monitoring and Targeting	1	1	0	2	0	1	0.83
High-Level Assessment	Energy Management Responsibilities	Energy Efficiency Awareness	Review of Energy	Performance	Ongoing Training	Market Awareness	Average
Awareness and Information	1	2	3	2	2	3	2.17



Appendix B: CEMP Detailed Description of Measure with Cost and Savings Estimates Breakdown

Retrofit - Capital				Annual Cost Estimates (\$/year)							Cumulative Annual Savings Estimates (\$/year)						
Description of Measures				2014	2015	2016	2017	2018	2019	Total	2014	2015	2016	2017	2018	2019	Total
Measure	Role	Cost	Savings														
Optimize BAS for major facilities	EEM/MECO is lead on project with documentation support from facility staff	\$10,000 per building x 2 building/year = 2 x \$10,000 = \$20,000	5% per building = \$300,000 x 5% = \$15,000	\$ -	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 100,000	\$ -	\$ 15,000	\$ 30,000	\$ 45,000	\$ 60,000	\$ 75,000	\$ 225,000
Add additional project meters	EEM/MECO is lead on project	\$3,000 per project x 2 projects/year = \$6,000	1% to 3% per project = 0.01 x \$20,000 x 3 projects/year = \$600	\$ 6,000	\$ 6,000	\$ 6,000	\$ 6,000	\$ 6,000	\$ 6,000	\$ 36,000	\$ 600	\$ 1,200	\$ 1,800	\$ 2,400	\$ 3,000	\$ 3,600	\$ 12,600
Investigate centralizing sub-metering monitoring and management	EEM/MECO is lead on project with support from facility staff to access sub-meters and feedback	\$10,000 to \$20,000 for study	N/A	\$ -	\$ 15,000	\$ -	\$ -	\$ -	\$ -	\$ 15,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Centralize sub-metering monitoring and management at largest facilities	EEM/MECO is lead on project with support from facility staff to access sub-meters and feedback	\$0.1/sq ft = \$0.1/sq ft x 1,500,000 x 10% of buildings centralized = \$15,000	5% to 10% per building = \$4,500,000 x 10% of buildings x 5% = \$22,500	\$ -	\$ -	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 60,000	\$ -	\$ -	\$ 22,500	\$ 45,000	\$ 67,500	\$ 90,000	\$ 225,000
Increase quantity of buildings with PowerStream Interval Metering	EEM/MECO is lead on project with support from IT and facility staff to install new meters	\$500 per building x 3 buildings = \$1,500	N/A	\$ -	\$ 1,500	\$ -	\$ -	\$ -	\$ -	\$ 1,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Establish an EMIS	EEM/MECO is lead on project	\$5,500	N/A	\$ 5,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 5,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Use EMIS in conjunction with project and sub-meters to track energy performance	EEM/MECO is lead on project	\$4,600 per year	N/A	\$ -	\$ 4,600	\$ 4,600	\$ 4,600	\$ 4,600	\$ 4,600	\$ 23,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
BAS training from BAS providers	EEM/MECO is lead on project with support from BAS providers and facility staff engagement	\$1,000 per session	1% to 3% per year = \$4,500,000 x 50% BAS x 50% requires training x 0.05% = \$5,625	\$ -	\$ 1,000	\$ 1,000	\$ 1,000	\$ -	\$ -	\$ 3,000	\$ -	\$ 5,625	\$ 11,250	\$ 16,875	\$ 16,875	\$ 16,875	\$ 67,500
Support lifecycle upgrades with funding, incentives, and studies	Facility staff leads lifecycle project development and implementation with EEM/MECO supporting energy measure investigation and recommendations	\$100,000 to \$175,000 per year = \$120,000	5% to 20% on new equipment	\$ 120,000	\$ 120,000	\$ 120,000	\$ 120,000	\$ 120,000	\$ 120,000	\$ 720,000	\$ 50,000	\$ 100,000	\$ 150,000	\$ 200,000	\$ 250,000	\$ 300,000	\$ 1,050,000
Support additional special events to promote energy awareness	EEM/MECO is lead on project	\$500 per event x 2 events/year = \$1,000	N/A	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 6,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Study best practice operating procedures for major equipment	EEM/MECO is lead on project but relies on staff for available data transfer and facility access	\$10,000 to \$15,000 per building type = \$10,000 x 2 building types/year = \$20,000	N/A	\$ -	\$ -	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 80,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Re-commission buildings as necessary	EEM/MECO is lead on project but relies on staff for available data transfer and facility access	\$0.15 to \$0.30 per ft ² - 1,500,000 sq ft x 10% of buildings x \$0.15/ft ² = \$22,500	5% to 20% per facility = \$4,500,000 x 5% savings x 5% of building = \$11,250	\$ -	\$ -	\$ 22,500	\$ -	\$ 22,500	\$ -	\$ 45,000	\$ -	\$ -	\$ 11,250	\$ 11,250	\$ 22,500	\$ 22,500	\$ 67,500
Sub-Total				\$ 132,500	\$ 169,100	\$ 210,100	\$ 187,600	\$ 209,100	\$ 186,600	\$ 1,095,000	\$ 50,600	\$ 121,825	\$ 226,800	\$ 320,525	\$ 419,875	\$ 507,975	\$ 1,647,600

Therefore, this plan proposes to invest \$1,095,000 from 2014 to 2019 in order to save a cumulative total of \$1,647,600 over the same period. Achieving the target savings is contingent on securing the necessary capital during the budget process each year.

Retrofit - Embedded Energy Manager/MECO Coordinator Soft Cost

Description of Measures				Annual Cost Estimates (\$/year)							Cumulative Annual Savings Estimates (\$/year)						
Measure	Role	Cost	Savings	2014	2015	2016	2017	2018	2019	Total	2014	2015	2016	2017	2018	2019	Total
Partner with Humber College to perform energy audits in lowest performing facilities	EEM/MECO is lead on project	\$500 per building x 2 building/year = 2 x \$500 = \$1,000	0.5% per building = \$300,000 x 0.5% = \$1,500	\$ -	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 5,000	\$ -	\$ 1,500	\$ 3,000	\$ 4,500	\$ 6,000	\$ 7,500	\$ 22,500
Enter building data into Portfolio Manager	EEM/MECO is lead on project	\$500 per year	N/A	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 3,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Form DREAM team	EEM/MECO is lead on project	\$1,000	N/A	\$ 1,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Evaluate Procurement Contracts	EEM/MECO is lead on project	\$5,000	TBD	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Provide facility staff with Powerview training and login information	EEM/MECO is lead on project	\$500 per session x 1 session/year = \$500	1% to 3% per year = \$3,000,000 x 10% with Powerview x 0.5% = \$1,500	\$ -	\$ 500	\$ 500	\$ 500	\$ -	\$ -	\$ 1,500	\$ -	\$ 1,500	\$ 3,000	\$ 4,500	\$ 6,000	\$ 7,500	\$ 22,500
Provide facility staff with EMIS	EEM/MECO is lead on project	\$500	N/A	\$ -	\$ 500	\$ -	\$ -	\$ -	\$ -	\$ 500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Use EMIS in conjunction with project and sub-meters to track energy performance	EEM/MECO is lead on project	\$1,000 per year	0.2% to 0.5% per year = \$4,500,000 x 0.2% = \$9,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 6,000	\$ 9,000	\$ 18,000	\$ 27,000	\$ 36,000	\$ 45,000	\$ 54,000	\$ 189,000
Support lifecycle upgrades with funding, incentives, and studies	Facility staff leads lifecycle project development and implementation with EEM/MECO supporting energy measure investigation and recommendations	\$30,000- \$40,000	5% to 20% on new equipment	\$ 30,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 35,000	\$ 205,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Support additional special events to promote energy awareness	EEM/MECO is lead on project	\$500 per event x 2 events/year = \$1,000	N/A	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 6,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Integrate into the monthly building manager forum to share best practices	EEM/MECO is support on project	\$2,500	0.1% per year = \$4,500,000 x 0.1% x 50% building staff attending = \$2,250	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 15,000	\$ 2,250	\$ 4,500	\$ 6,750	\$ 9,000	\$ 11,250	\$ 13,500	\$ 47,250
Establish competition by facility type	EEM/MECO is support on project and relies on staff to reduce load. Will provide best practice support and assistance in load identification	\$2,000 per event	0.1% per event = \$4,500,000 x 0.05% x 50% participation = \$1,125	\$ -	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 10,000	\$ -	\$ 1,125	\$ 2,250	\$ 3,375	\$ 4,500	\$ 5,625	\$ 16,875
Create energy management plans for reporting	EEM/MECO is lead on project	\$6,000 in 2014, \$1,000 thereafter	N/A	\$ 6,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 6,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Externally report annually on energy consumption and GHG emissions	EEM/MECO is lead on project	\$2,000 per year	N/A	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 12,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Internally report on energy consumption and costs	EEM/MECO is lead on project but relies on staff for feedback	\$2,000 to \$5,000 per year	N/A	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000	\$ 18,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Implement best practice operating procedures for major equipment	EEM/MECO is lead on project but relies on staff for available data transfer and facility access	\$5,000 to \$10,000 per building type = \$2,500 x 7 = \$17,500	1% per year = \$4,500,000 x 0.005 x 0.5 x 1 years = \$11,250	\$ -	\$ -	\$ -	\$ 17,500	\$ 17,500	\$ 17,500	\$ 52,500	\$ -	\$ -	\$ -	\$ 11,250	\$ 22,500	\$ 33,750	\$ 67,500
Re-commission buildings as necessary	EEM/MECO is lead on project but relies on staff for available data transfer and facility access	\$0.05 per ft ² - 1,500,000 sq ft x 10% of buildings x \$0.05/ft ² = \$7,500	5% to 20% per facility = \$4,500,000 x 0.1% savings x 5% of building = \$2,250	\$ -	\$ -	\$ 7,500	\$ -	\$ 7,500	\$ -	\$ 15,000	\$ -	\$ -	\$ 2,250	\$ 2,250	\$ 4,500	\$ 4,500	\$ 13,500
Establish the ECF	EEM/MECO is lead on developing funding model	\$1,000 to \$6,000	N/A	\$ -	\$ 3,000	\$ -	\$ -	\$ -	\$ -	\$ 3,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Utilize the ECF to fund energy projects	MECO will primarily use ECF to fund projects and rely on Finance to assist in fund management	\$1,000 per year	N/A	\$ -	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 2,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Sub-Total				\$ 52,000	\$ 53,500	\$ 57,500	\$ 67,500	\$ 74,500	\$ 72,000	\$ 377,000	\$ 11,250	\$ 26,625	\$ 44,250	\$ 70,875	\$ 99,750	\$ 126,375	\$ 379,125

The table above outlines the expected staffing cost expenditure in order to save the estimated cumulative annual savings against the baseline. The Embedded Energy Manager/MECO Coordinator is an existing member of staff. The table is used for illustrative purposes to allocate time and resources to each project/program. All of the savings accumulated by each project will carry over into subsequent years.

Retrofit - City Staff Soft Cost

Description of Measures				Annual Cost Estimates (\$/year)							Cumulative Annual Savings Estimates (\$/year)						
Measure	Role	Cost	Savings	2014	2015	2016	2017	2018	2019	Total	2014	2015	2016	2017	2018	2019	Total
Partner with Humber College to perform energy audits in lowest performing facilities	Facility maintenance staff assists in tours, access to rooms, answer questions, review reports (10-15 hours)	\$500 per building x 2 building/year = 2 x \$500 = \$1,000	0.5% per building = \$300,000 x 0.5% = \$1,500	\$ -	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 5,000	\$ -	\$ 1,500	\$ 3,000	\$ 4,500	\$ 6,000	\$ 7,500	\$ 22,500
Form DREAM team	Facility managers assist in energy discussions, best practice sharing, relaying information (1 hour/month/person)	1 hours x 12 x \$35/hour x 11 staff = \$5,000	N/A	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Provide facility staff with Powerview training and login information	Facility supervisors and maintenance staff receive training and use Powerview for 0.5 hour every month to track consumption	7 hour x 5 staff x \$35/hour = \$1,225	0.5% per year = \$3,000,000 x 10% with Powerview x 0.5% = \$1,500	\$ -	\$ 1,000	\$ 1,000	\$ 1,000	\$ -	\$ -	\$ 3,000	\$ -	\$ 1,500	\$ 3,000	\$ 4,500	\$ 6,000	\$ 7,500	\$ 22,500
Provide facility staff with EMIS training and use EMIS monthly	Facility supervisors and managers receive training and review consumption and cost with monthly report (2 hr per staff)	2 hr x 20 staff x \$35/hour = \$1,400	N/A	\$ -	\$ 1,500	\$ -	\$ -	\$ -	\$ -	\$ 1,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Support lifecycle upgrades with funding, incentives, and studies	Facility staff leads lifecycle project development and implementation with EEM/MECO supporting energy measure investigation and recommendations	10 hours x \$35/hour x 20 staff = \$7,000	N/A	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 42,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
BAS training from BAS providers	Facility supervisors assist in obtaining BAS access, reviewing schedules, and optimizing to usage (10 hours)	\$1,000 per session for similar BAS	1% to 3% per year = \$4,500,000 x 50% BAS x 50% requires training x 0.05% = \$5,625	\$ -	\$ 1,000	\$ 1,000	\$ 1,000	\$ -	\$ -	\$ 3,000	\$ -	\$ 5,625	\$ 11,250	\$ 16,875	\$ 16,875	\$ 16,875	\$ 67,500
Building Operator Energy Management Course	Facility supervisors and maintenance staff attend an energy training course to enhance energy management knowledge	\$250 per person x 20 staff = 5,000	1% per year = \$4,500,000 x 0.5% savings x 50% participation = \$11,250	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ 5,000	\$ 10,000	\$ -	\$ -	\$ 11,250	\$ 22,500	\$ 33,750	\$ 45,000	\$ 112,500
Integrate into the monthly building manager forum to share best practices	Facility managers assist in energy discussions, best practice sharing, relaying information (0.5 hour/month/person)	0.2% per staff salary involved = 0.02 x \$70,000 salary x 20 staff = \$2,800	0.1% per year = \$4,500,000 x 0.1% x 50% building staff attending = \$2,250	\$ 2,800	\$ 2,800	\$ 2,800	\$ 2,800	\$ 2,800	\$ 2,800	\$ 16,800	\$ 2,250	\$ 4,500	\$ 6,750	\$ 9,000	\$ 11,250	\$ 13,500	\$ 47,250
Establish competition by facility type	Facility managers lead on identifying and reducing loads to compete in competition (10 hours)	\$1,000 per event	0.1% per event = \$4,500,000 x 0.05% x 50% participation = \$1,125	\$ -	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ 5,000	\$ -	\$ 1,125	\$ 2,250	\$ 3,375	\$ 4,500	\$ 5,625	\$ 16,875
Create energy management plans for reporting	CET assist in data gathering and plan review	\$1,000	N/A	\$ 1,000	\$ -	\$ -	\$ -	\$ -	\$ 1,000	\$ 2,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Internally report on energy consumption and costs	CET create and review templates for facility staff. Facility staff review reports and compare to budgets	\$1,500 per year	0.1% per year	\$ 1,500	\$ 1,500	\$ 1,500	\$ 1,500	\$ 1,500	\$ 1,500	\$ 9,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Roll out Project Hand Over Procedure to Facility Staff	Asset Management: Implement full record keeping for projects to collect all available documentation	5% per staff salary = 5% x \$70,000 salary x 1 staff = \$3,500	N/A	\$ 3,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 3,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Work with facility staff to retrieve all new building documentation	Project managers and Asset Management: Implement full record keeping for projects to collect add available documentation (7 hours per staff)	0.1% per staff salary = 0.1% x \$70,000 salary x 20 staff = \$1,400	N/A	\$ 1,400	\$ 1,400	\$ 1,400	\$ 1,400	\$ 1,400	\$ 1,400	\$ 8,400	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Implement best practice operating procedures for major equipment	Facility staff assist in obtaining information on major equipment and implementing new operating procedures (20 hours per staff)	\$8,000 per building type = \$8,000 x 2 + 40 hours x \$35/hour = \$17,500	1% per year = \$4,500,000 x 0.005 x 0.5 x 1 years = \$11,250	\$ -	\$ -	\$ -	\$ 17,500	\$ 17,500	\$ 17,500	\$ 52,500	\$ -	\$ -	\$ -	\$ 11,250	\$ 22,500	\$ 33,750	\$ 67,500
Re-commission buildings as necessary	Facility staff support on projects for available data transfer, operation discussions, and facility access (40 hours per staff)	\$0.05 per ft ² - 1,500,000 sq ft x 10% of buildings x \$0.05/ft ² = \$7,500	N/A	\$ -	\$ -	\$ 1,400	\$ -	\$ 1,400	\$ -	\$ 2,800	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Establish the ECF	CET establish guidelines, funding model and breakdown (12 hours each)	\$1,000 to \$6,000	N/A	\$ -	\$ 3,000	\$ -	\$ -	\$ -	\$ -	\$ 3,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Utilize the ECF to fund energy	Finance administer ECF (10 hours)	\$500 per year	N/A	\$ -	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 2,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Sub-Total				\$ 22,200	\$ 26,700	\$ 18,600	\$ 34,700	\$ 34,100	\$ 38,700	\$ 175,000	\$ 2,250	\$ 14,250	\$ 37,500	\$ 72,000	\$ 100,875	\$ 129,750	\$ 356,625

The table above outlines the expected staffing cost expenditure in order to save the estimated cumulative annual savings against the baseline. City Staff are identified resources that will assist in implementing the CEMP. The table is used for illustrative purposes to allocate time and resources to each project/program. All of the savings accumulated by each project will carry over into subsequent years.

