



Energy Conservation and Demand Management Plan for Municipal Buildings

2015-19

City of Kingston

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Introduction

Ontario Regulation 397/11 under the *Green Energy Act 2009* requires public agencies, including municipalities, to report on their energy consumption and greenhouse gas (GHG) emissions annually beginning in 2013 and to develop and implement energy Conservation and Demand Management (CDM) plans starting in 2014. This 5-year CDM Plan encompasses all facilities used by the City of Kingston for municipal operations except for buildings and facilities related to the treatment or pumping of water or sewage, which are managed by Utilities Kingston. Seasonal buildings which are neither heated nor cooled are not included, nor are buildings leased to non-municipal tenants. The facilities included in this report are listed in Appendix A.

Alignment with Community and Corporate Sustainability

The City of Kingston is a partner to the community-based Sustainable Kingston Plan. The adoption of a conservation and demand management plan contributes to the goals and objectives identified specifically within the environmental pillar of the community plan focused on energy conservation, air quality and the reduction of greenhouse gas emissions. To address its internal operational requirements and engage employees in sustainability, the City also adopted a corporate sustainability strategy in 2012 focused on energy conservation and emission reduction.

In addition, the City of Kingston adopted both a community and a corporate climate plan in 2004 with a goal to reduce corporate emissions by 20% by 2014 based on year 2000 levels. As of the latest audit in 2011 the corporation had realized an overall emissions reduction of 22%, despite a 12% increase in overall energy consumption. The decrease in emissions is largely attributed to a cleaner energy mix in the province. Note that these figures apply not just to municipal buildings, but incorporate fleet and other activities.

The City of Kingston is developing a Corporate Climate Action Plan aimed at reducing our greenhouse gas emissions. This will be an extension of the Corporate Sustainability Plan. While the CDM plan concerns only buildings, the Climate Action Plan will have a broader focus, including the environmental impacts of the corporation's vehicle fleet, streetlights, water, waste water and waste management activities.

Vision

We have a corporate culture of sustainability that values and promotes energy conservation and GHG emission reduction, from senior management down to front line staff.

We understand how energy is used in each of our facilities and we have the right equipment, processes and people in place to manage it effectively.

Goals and Objectives

1. To continuously improve the energy efficiency of our facilities in order to reduce operating costs, energy consumption and greenhouse gas emissions;
2. To provide our building operators with the equipment and training they need to reduce energy consumption and demand in the facilities they manage;
3. To implement energy-saving retrofits at some of our larger facilities;
4. To set new energy consumption and demand targets for these facilities based on the expected outcome of the retrofits;
5. To continue an ongoing program of building automation system (BAS) recommissioning to improve our ability to monitor and track energy usage in our larger facilities;
6. To ensure that our renovation and construction projects embody best practices in energy-efficient design;
7. To expand our renewable energy generation portfolio.

Organizational Understanding

The Facilities Management and Construction Services (FMCS) department is responsible for energy management within the portfolio of buildings that the department maintains. Others including Utilities Kingston, Kingston Fire & Rescue, Recreation & Leisure Services, Kingston Frontenac Public Library, etc. are responsible for energy management in their facilities. Reporting under the Green Energy Act is the responsibility of FMCS.

Summary of Current Energy Consumption, Cost and GHGs

The following table compares the total annual energy consumption, cost and greenhouse gas emissions for City facilities in 2011 and 2012, as per the annual reports submitted to the Ministry of Energy. Note that these numbers have not been adjusted for weather or occupancy rates, both of which can be significant factors in energy usage.

Year	Energy Consumption	Energy Cost (\$)	GHG Emissions (eCO ₂)
2012	49,000 eMWh	\$3.9 M	6,362 tonnes
2011	55,000 eMWh	\$4.0 M	7,309 tonnes

Please see Appendix A for the detailed 2012 Energy Consumption and GHG report for City of Kingston facilities.

Accomplishments to Date

Energy Retrofits

In 2009 the City embarked on an ambitious project to implement energy and water efficiency retrofits in 38 municipal buildings. The measures were predicted to save \$348,000 annually. The project cost approximately \$3 M and had a payback time of 8 years. The savings were guaranteed under an Energy Performance contract with MCW Custom Energy Solutions. The two-year monitoring and tracking period is now complete, and the results show that the actual savings over the portfolio of buildings have exceeded the target by a healthy margin. With the continued diligence of Facilities Management and the building operators, these savings should be sustainable for the duration of the payback period and beyond.

In connection with the energy retrofit project, staff launched a poster campaign to promote energy conservation amongst staff and visitors in City facilities. The posters were intended to highlight the energy retrofits being done in the buildings and to suggest actions that individuals could take to curb their energy usage both on the job and at home. The posters were widely distributed and some are still on display.

LEED Buildings

The City of Kingston's Enhanced Municipal Green Building Policy provides for the design and construction of municipally owned or funded new building and major renovation projects to proceed in a fashion that ensures environmental, economic and social factors are taken into consideration. The policy requires that major renovation and construction projects achieve silver level certification in the Canada Green Building Council's Leadership in Energy and Environmental Design (LEED) program. The goal is to minimize energy costs, waste and greenhouse gas emissions and to protect indoor air quality.

Since the policy's inception, several of the City's major building projects have achieved LEED Certification:

- Utilities Kingston Office Building (targeting LEED Gold)
- Artillery Park Recreation Centre (targeting LEED Silver)
- Transit Facility Expansion (targeting LEED Silver)
- Public Works Operations Centre (targeting LEED Gold)
- Ravensview Administration Building (LEED Certified)

- INVISTA Centre (LEED Gold)
- Rogers K-Rock Centre (LEED Silver)
- Calvin Park Library (LEED Gold)
- Kingston Police Headquarters (LEED Gold)

Renewable Energy

Rooftop Solar PV Projects

In 2011-12 the City successfully implemented a 200 kW rooftop solar photovoltaic (PV) installation under the Ontario Power Authority's (OPA) Feed-in-Tariff (FIT) and eleven 10 kW rooftop solar PV installations under the microFIT program. These facilities will supply renewable energy to the electricity grid for 20 years at a fixed price. The table in Appendix B summarizes the location, energy output, cost and revenue for these projects.

Work in Progress

Building Automation System (BAS) Upgrades

Virtual Server

The City's larger facilities have building automation systems (BAS) to control the heating, ventilation and air-conditioning, lighting, ice plant controls and other equipment. Providing remote access to all of these systems through a single virtual server will improve our ability to monitor and manage our facilities. The virtual server project began in the fall of 2013 and will be completed in 2014.

Utility Meter Output to BAS

Connecting the electrical, natural gas and water meters for each building to the BAS will provide facility managers with the information they need to optimize the systems to reduce energy demand and consumption. This information can also be used for energy monitoring, tracking and reporting. This is an ongoing project.

Building Operator Training

Knowledgeable building operators are the key to better energy management in facilities. Building operators need to be familiar with the BAS interface and have a clear understanding of how their actions influence energy consumption and demand. Building operator training is done prior to turnover of any construction, renovation or energy retrofit project and on an ongoing basis as required.

Proposed Measures

Energy Retrofits

Several buildings have been added to the City's real estate portfolio since the 2008 energy retrofit feasibility study. In 2014 the City hired consultants to conduct energy audits of some of the newer facilities. The intention is to carry out the retrofits over the next four years as budgets permit. The following is an outline of the proposed energy retrofit measures at the INVISTA Centre, the Rogers K-Rock Centre, the Kingston Police Headquarters, Cataraqi Community Centre, the Grand Theatre and the British Whig Building.

The following table summarizes the proposed retrofits. The scope of work at the Kingston Police Headquarters and the Cataraqi Community Centre will be determined after further study. A more detailed summary is included in Appendix C.

Building	Annual energy costs (2012)	Cost of retrofits	Soft cost & contingency allowance (15%)	Annual energy savings	Available incentives	Simple payback time	GHG savings (tons eCO ₂)
INVISTA Centre	\$673,000	\$446,000	\$66,900	\$51,000	\$27,000	9.5 yrs	122
K-Rock Centre	\$347,000	\$82,000	\$12,300	\$8,000	\$6,000	11.0 yrs	12
Grand Theatre	\$89,000	\$74,000	\$11,100	\$12,000	\$5,000	6.7 yrs	11
Totals	\$1,109,000	\$602,000	\$90,300	\$71,000	\$38,000	9.2 yrs	145

INVISTA Centre

The INVISTA Centre at 1350 Gardiners Road, a year-round 4-pad arena and fitness centre, opened in 2008. The building received LEED Gold certification. At 16,723 m², the facility is the largest building in the City's portfolio and consumes the most energy. The facility has been enrolled in the DR3 Demand Response program since 2010, but efforts to reduce demand during heat waves have been hampered by the need to maintain ice quality.

In 2012 this facility consumed 374,000 cubic meters (m³) of natural gas and 4,525,000 kilowatt-hours (kWh) of electricity at a total cost of \$673,000.

An energy audit of this facility was completed in May 2014. Despite the fact that this building is of recent construction and a LEED Gold facility, the audit found energy savings opportunities. This is mainly due to the availability of new technologies in lighting and ice plant controls.

The proposed efficiency measures will provide a more controllable, more efficient and more easily maintained energy infrastructure while reducing energy costs by 8% per year as compared to current energy costs. The overall cost of the selected measures, including soft costs and contingency allowance and factoring in available incentives, is \$486,000, the annual projected savings are \$51,000 and the expected payback time is 9.5 years. The measures would result in annual savings of 381,000 kWh of electricity and 42,000 m³ of natural gas, resulting in a reduction in greenhouse gas emissions of 122 tonnes equivalent carbon dioxide (eCO₂). Peak monthly electrical demand would drop by 43 kW.

The energy retrofit measures include the following:

- Retrofit 32-watt T8 lamps and standard ballasts to 28-watt T8 and high efficiency electronic ballasts.
- Replace existing metal halide fixtures in the parking lot and wall-mounted fixtures with new LED fixtures.
- Replace the high intensity discharge metal halide fixtures over the ice pads with fluorescent T5HO fixtures. This will result in energy savings in the ice pad lighting and will reduce the amount of cooling energy used to maintain the ice. This measure also includes the installation of bi-level switching.
- Upgrade the ice plant controls to a CIMCO 6000E, including floating head pressure controls to improve energy efficiency.
- Replace the existing natural gas-fired radiant heaters over the spectator stands with in-slab radiant heating from the ice plant.
- Implement a time-of-day schedule on heat recovery ventilator (HRV-1) to match HRV-2 and reduce equipment operation.
- Recommission the controls system to optimize operating sequences.

Rogers K-Rock Centre

Rogers K-Rock Centre is a 6,700 seat, award-winning sports and entertainment complex owned by the City of Kingston. Home to the Frontenacs Junior A Hockey Team and host to 120 concerts, hockey games, and other events each year, the LEED Silver facility first opened its doors in 2008 and has been implementing green practices into its daily operations ever since.

In 2012 this facility consumed 107,000 m³ of natural gas and 2,632,000 kWh of electricity, at a total cost of \$347,000.

The Rogers K-Rock Centre was included in the 2009-10 energy retrofits and, as a result, has experienced significant savings in energy and water usage. Energy usage in the building was up in 2013 due to changes in facility operation; however recent changes to the scheduling of the air handling units will likely rectify this situation.

An energy audit of this facility was completed in May 2014. The recommended energy retrofit measures include the following:

- Retrofit 32W T8 lamps and standard ballasts to 28W T8 and high efficiency electronic ballasts.
- Retrofit existing exterior lighting with LED lamps.
- Upgrade the ice plant controls system including floating head pressure controls to improve energy efficiency.
- Implement a time-of-day schedule on all air handling units to reduce equipment operation (recently completed).
- Recommission the building automation controls system to optimize operating sequences.
- Seal windows, caulk or foam roof-wall intersection and seal penetrations through the building shell to reduce air leakage. Weather-strip interior doors to ice surface and heated change rooms.

Other measures were identified, but the potential savings were quite small in relation to the costs. There are opportunities for energy savings through interior LED lighting conversion but the payback time is very long at current prices. This measure will be revisited in a few years when improved technology and lower priced fixtures come on the market.

The proposed efficiency measures will provide a more controllable, more efficient and more easily maintained energy infrastructure while reducing energy costs by 1.8% per year as compared to current energy costs. The overall cost of the selected measures, including soft costs and contingency allowance and factoring in available incentives, is \$88,000, the annual projected savings are \$8,000 and the expected payback time is 11 years. The measures would result in annual savings of 68,000 kWh of electricity and 2,500 m³ of natural gas, resulting in a reduction in greenhouse gas emissions of 12 tonnes eCO₂. Peak monthly electrical demand would drop by 5.4 kW.

Kingston Police Headquarters

The Kingston Police Headquarters incorporates conventional security considerations with “green” building design. This two-storey, 11,000 m², LEED Gold facility houses offices and training facilities, forensic laboratories, vehicle maintenance facilities, detention facilities and staff support rooms.

In 2012 this facility consumed 111,000 m³ of natural gas and 2,143,000 kWh of electricity, at a total cost of \$268,000.

An energy audit of this facility was completed in June 2014. The study found that the facility is among the top tier for buildings of its type in energy efficiency. Most of the systems are fully automated and are equipped with up-to-date energy efficiency devices and functions such as VFD fan control, exhaust heat recovery and CO₂ ventilation control. With most systems integrated into the building automation system, essential system-wide energy management controls are in place. Most of the systems are in good operating condition and the devices are properly maintained.

However, the study found opportunities for improvement. The energy retrofit measures under consideration include the following:

- Retrofitting compact fluorescent lights with LED's in common areas;
- Retrofitting exterior lights with LED's;
- Retrofitting 32W lamps with 25W high performance lamps in corridors;
- Installing task light occupancy controls;
- Downsizing the chiller;
- Optimizing the discharge air static pressure on the air handling units during unoccupied periods;
- Optimizing the HVAC controls in the firing range during unoccupied periods;
- Using ventilated warm air from the electrical room to heat the parking garage in winter;
- Installing a stand-alone domestic hot water system.

Further study is needed to determine the feasibility and cost of these measures. A phased program of retrofits will be carried out over the next few years with priority given to the measures with the quickest paybacks and highest potential to reduce energy consumption, cost and greenhouse gas emissions.

Cataraqi Community Centre

The Cataraqi Community Centre is a two-storey arena facility with two ice pads, dressing rooms, hall, meeting rooms, outdoor softball diamond, pro shop and canteen.

In 2012 this facility consumed 79,000 m³ of natural gas and 1,337,000 kWh of electricity, at a total cost of \$207,000.

The building was included in the 2009-10 energy retrofit project, however there are still opportunities for additional measures including the following:

- Floating head pressure upgrade to the ice plant controls;
- Modifications to improve the efficiency of the dehumidification unit;
- Interior LED lighting conversion;
- Parking lot lighting LED conversion;
- Replacing the aging electric hot water system for the lobbies with a boiler.

The selection of measures for implementation will depend on cost, feasibility and payback time.

Grand Theatre

The historic Grand Theatre at 218 Princess Street re-opened in 2008 after extensive restoration and renovation. The Grand is Kingston's prime performing arts venue for hundreds of professional and amateur performances annually including ballet, modern dance, theatre, variety, musicals and comedy. The building has a floor area of 2600 m².

In 2012 this facility consumed 52,000 m³ of natural gas and 562,000 kWh of electricity, at a total cost of \$89,000.

An energy audit of this building was completed in May 2014. The study found several opportunities for energy retrofits. The recommended measures include the following:

- Install LED lamps or new LED fixtures to replace compact fluorescent and incandescent sources.
- Replace existing incandescent lighting under the marquee with LED lamps.
- Implement a time-of-day schedule on all air handling units to reduce equipment operation.
- Add a CO₂ sensor in the return air duct of the air handling unit that serves the main theatre to control the variable speed drive.

Other measures were identified but the potential savings were quite small in relation to the costs, making the payback times quite long.

The overall cost of the selected measures, including soft costs and contingency allowance and factoring in available incentives, is \$80,000, the annual projected savings are \$12,000 and the expected payback time is 6.7 years. The measures would result in annual savings of 104,000 kWh of electricity, resulting in a reduction in greenhouse gas emissions of 11 tonnes eCO₂. Peak monthly electrical demand would drop by 19 kW.

British Whig Building

The British Whig Building at 310 King Street East had been leased for municipal offices since 2005 and was purchased by the City in 2012. The building is four storeys high with a total area of 2620 m². The ground floor is mainly occupied by a restaurant; the upper three floors house municipal administrative offices. The energy audit does not include the restaurant. The building was built in 1894 and was gutted and renovated in 2005.

In 2012 the City-occupied portion of the facility consumed 18,000 m³ of natural gas and 501,000 kWh of electricity at a total cost of \$71,000.

An energy audit of this building was completed in May 2014. The findings show the building to be one of the most energy-efficient office buildings in the consultant's database. While some potential energy-saving retrofits were identified, the overall payback time was nearly 20 years. The potential retrofit measures identified included building envelope sealing, lighting retrofit and redesign and conversion of exterior light fixtures to LED's.

Based on the findings of the audit, we will not be pursuing energy retrofits in this building in the short term.

A separate project under consideration is the modification of the heating, ventilation and air-conditioning (HVAC) system to improve thermal comfort in the building. This will not necessarily result in energy savings; however energy efficiency will be a key factor in the selection of new equipment.

Monitoring and Tracking

Monitoring and tracking energy consumption in over fifty buildings has been a challenging and time-consuming task. Until recently, paper bills were the only source of information for many of the facilities. In the past couple of years, the utility companies that serve City of Kingston facilities (Kingston Hydro, Hydro One and Union Gas) have begun to recognize the need to provide utility data to their major clients in electronic format, both through web-based portals and summary reports on request. This will greatly enhance our ability to monitor and track energy usage.

Monitoring and verification of building systems and energy consumption and demand is an ongoing responsibility of the Facilities Management and Construction Services department. The following processes will be undertaken or enhanced:

- Optimizing building automation systems to enhance occupant comfort while reducing energy consumption and demand;
- Establishing energy monitoring, tracking and reporting processes;
- Establishing preventive maintenance programs for HVAC systems;

- Conducting technical analyses of building equipment (e.g. infrared thermography, vibration analysis, etc.);
- Creating monthly building performance reports for the larger facilities;
- Verifying utility bills for the larger facilities;
- Holding quarterly meetings with facility operators and managers to go over facility performance and trend data while discussing potential projects and their priority level;
- Identifying energy retrofit and recommissioning opportunities;
- Implementing energy retrofits and recommissioning;
- Monitoring and maintaining the rooftop solar PV systems;
- Producing annual energy and greenhouse gas emissions reports;
- Using energy management software to monitor and track energy consumption and demand, verify utility bills and track savings from recommissioning efforts and energy retrofit projects.

Renovation and Construction Projects

POA Relocation

The Provincial Offences Act (POA) courtroom and offices are currently housed in leased space and share a courtroom and other facilities with the provincial criminal court. Plans are underway to move the POA into the ground floor of the City's building at 362 Montreal Street in 2014-15.

As part of the project, the building envelope will be upgraded with better insulation under the overhanging floors and joint sealants where required. Thermographic scanning was undertaken in 2014 to determine heat loss trouble spots. The project will use energy-efficient lighting and controls.

Renovations to 1211 John Counter Boulevard

Customer service area. The City's development hub at 1211 John Counter Boulevard will be renovated in 2015 after Utilities Kingston vacates the second floor and moves into their new office building next door. The focus will be on improving customer service related to development review, building services and engineering services. The project will also enhance the staff work areas and will allow for some staff who currently work off-site to move in with their respective departments.

Mechanical upgrades. An engineering study is underway to determine the extent of mechanical upgrades needed in the facility. Energy efficiency will be a key factor in the selection of new equipment.

Lighting sensors. Funds have been set aside for the installation of lighting sensors in the building. The sensors are expected to reduce the building's electrical consumption by over 14,000 kWh per year. The project is expected to cost \$9,000 and to save \$3,000 per year. Factoring in available incentives, the project is expected to have a payback time of just over two years.

In 2012 this facility consumed 79,000 m³ of natural gas and 376,000 kWh of electricity, at a total cost of \$727,000.

The project will use energy-efficient lighting, lighting controls and high-efficiency mechanical equipment in order to reduce energy consumption and demand.

Fleet Maintenance Garage

The City's aging fleet maintenance garage on Railway Street will be replaced with a new facility within the next few years. Preliminary planning is underway. The new facility will be designed to LEED Silver standards wherever possible and will target a high level of energy efficiency.

Asset Rationalization Process

Demolishing, selling or repurposing surplus buildings reduces the overall floor area to be serviced by the City resulting in energy and operating cost savings. Hangar 4 at Kingston Airport is no longer fit for use and will be demolished in 2015. Equipment that is currently stored in the hangar will be moved to vacant space in other municipal buildings.

Other Initiatives

LED Lighting Conversion

The City has recently introduced a program to convert all street lights to LED technology and is currently reviewing park lighting. In this context, the energy audits considered the conversion of building lighting to LED. While the payback times for exterior LED conversion were reasonable in some buildings, the paybacks for interior LED conversion were very long at current prices. There have been significant advances in LED lighting in recent years. The products are still relatively expensive compared to other lighting technologies but the prices are dropping. Our intention is to revisit the question of LED conversion in City facilities in 2018-19, at which time the measure may have a considerably better payback.

Window Coverings

Films and window coatings can be an effective way to reduce unwanted solar heat gain and improve occupant comfort. Several facilities, including City Hall and the British Whig Building, may be candidates for window treatments. This will be further investigated, and projects that offer energy savings, reasonable payback times and occupant comfort benefits will be pursued.

Renewable Energy

Rooftop Solar Photovoltaic (PV) Projects

The City has a feed-in-tariff (FIT) contract with the Ontario Power Authority (OPA) for a new 100 kW rooftop solar photovoltaic installation on the Biosolids Storage building at the Ravensview Wastewater Treatment Plant. Installation is scheduled for the summer of 2014. The project is expected to cost \$400,000 and generate 120,000 kWh of electricity annually. Annual revenues are expected to average \$65,000 for a simple payback 6 years.

Solar Thermal Projects

The outdoor pool at the Memorial Centre and the newly renovated Artillery Park Recreation Centre both use rooftop solar glycol panels to heat water for domestic use, swimming pools and showers.

Ground Source Energy

The terminal at Norman Rogers Airport uses ground-source heat pumps to supplement the heating and cooling.

This plan was endorsed by the City of Kingston Corporate Management Team
on June 11, 2014.

Appendix A - 2012 Energy Consumption and GHG Report

Operation Name	Address	Total Floor Area (m2)	Energy Purchased and Consumed				Total	
			Electricity	Natural Gas	Fuel Oil 1 & 2	Propane	GHG Emissions (Kg)	Energy Intensity (ekWh/sqft)
			kWh	m3	Litres	Litres		
Centre 70	3 Days Rd.	2,705	419,701	25,033			80,904	0.91
Kingston Area Recycling Centre	196 Lappans Lane	2,676	467,921				37,434	0.63
Cataraqui Community Centre	1030 Sunnyside Rd.	8,826	1,337,474	78,786			255,953	0.89
Rodden Park House	87-89 Norman Rogers Dr.	309	764				61	0.01
Kingston Police Storage	717 Division St.	446		1,926			3,641	0.17
1211 John Counter Blvd.	1211 John Counter Blvd.	2,971	375,842	79,013			179,451	1.47
City Hall	216 Ontario St.	4,408	929,910	38,238			146,687	1.09
Former County of Frontenac Works Garage	546 Gardiners Rd.	566		4,547			8,597	0.31
Operations Centre	701 Division St.	3,035	486,631	100,961			229,810	1.85
Portsmouth Olympic Harbour	53 Yonge St.	5,987	684,726	69,793			186,731	0.86
Airport Terminal	1114 Len Birchall Way	1,360	434,160	32,153			95,522	2.05
Depot 610	610 Montreal St.	160	8,920	3,299			6,951	0.99
Rodden Park Barn	111 Norman Rogers Dr.	820	20,394	2,655			6,651	0.21
KFPL - Central Branch	130 Johnson St.	5,577	469,082	36,114			105,805	0.55
KFPL - Isabel Turner Branch	935 Gardiners Rd.	3,013	463,019	38,263			109,383	1.04
City Greenhouse	99 Norman Rogers Dr.	764	16,349	38,734			74,539	2.02
KFPL - Pittsburgh Branch	80 Gore Rd.	622	56,171	6,101			16,028	0.70
KFPL - Kingscourt Branch	115 Kirkpatrick St.	311	23,276	5,841			12,905	0.99
British Whig Building	310 King St. East	2,620	500,745	18,355			74,762	0.96
Transit Facility	1181 John Counter Blvd.	2,631	539,196	181,007			385,352	3.37
Airport Garage	1095 Len Birchall Way	510	18,377	15,547			30,864	1.30
KARC Garage	2709 Creeksford Rd.	7,336	17,960	32,082			62,092	0.18
JK Tett Centre	370 King St. West	3,696		42			79	0.00
Parks & Rec Storage Garage	2711 Creeksford Rd.	1,009	9,671	16,688			32,324	0.67
KFPL - Calvin Park Branch	88 Wright St.	1,021	148,749	13,525			37,471	1.03
Madoma Community Centre	1805 Hwy 2 East	421	6,442		6,586		18,478	0.66
Fire Station #1	1648 Joyceville Rd.	1,133	39,484		16,339		47,722	0.68
Fire Station #2	3505 Brewers Mills Rd.	268	39,521		4,144		14,464	1.13
Fire Station #3	211 Gore Rd.	824	36,927	17,337			35,732	0.97
623 King Street-Former Portsmouth Town Hall	623 King St.	186	8,802	4,278			8,792	1.05
Fire Station #4	271 Brock St.	2,301	130,882	27,056			61,623	0.65
Fire Station #5	170 Railway St.	729	24,963	8,691			18,428	0.58
Fire Station #6	262 Palace Rd.	455	24,022	12,411			25,386	1.23
Fire Station #7	905 Woodbine Rd.	1,848	268,179	23,977			66,786	1.02
Fire Station #8	1485 Unity Rd.	754	53,581	12,925			28,723	0.91
Pump House Steam Museum	23 Ontario St.	697	66,618	18,660			40,609	1.37
Fire Station #9	2835 Hwy 38	613	46,913			15,363	27,473	0.91
Fire Station #10	127 Days Rd	456	18,597	10,181			20,736	1.00
Artillery Park Aquatic & Fitness Centre	76 Ordnance St..	2,427	304,053	74,862			165,860	1.63
Harold Harvey Centre	42 Church St.	2,165	47,605	11,183			24,951	0.28
MacLachlan Woodworking Museum	2993 Hwy 2	113	4,993		898		2,849	0.47
Cooks Brothers Arena	692 Bagot St.	2,474	120,177	6,864			22,591	0.28

Operation Name	Address	Total Floor Area (m2)	Energy Purchased and Consumed				Total	
			Electricity	Natural Gas	Fuel Oil 1 & 2	Propane	GHG Emissions (Kg)	Energy Intensity (ekWh/sqft)
			kWh	m3	Litres	Litres		
Belle Park Clubhouse	731 Montreal St.	366	121,322		3,655		19,674	1.58
362 Montreal Street	362 Montreal St.	3,438	726,311	68,740			188,067	1.53
Meadowcrest	360 Hwy 2	269	20,579		4,032		12,643	0.86
Grand Theatre	218 Princess St.	2,601	561,873	52,153			143,552	1.54
Rideaucrest Home	175 Rideau St.	10,577	3,025,653	263,753			740,711	1.98
Kingston Police Headquarters	705 Division St.	11,282	2,142,584	108,968			377,425	1.05
Oakwood Daycare	33 Compton St.	610	83,956				6,716	0.50
INVISTA Centre	1350 Gardiners Rd.	16,723	4,524,583	374,224			1,069,485	1.83
Kingston Fire & Rescue Headquarters	500 O'Conner Dr.	1,455	279,043	23,532		15,365	90,537	1.58
Memorial Centre	303 York St.	5,714	932,742	181,255			417,305	1.80
K-Rock Centre	1 Barrack St.	15,445	2,631,818	106,973			412,791	0.88
Wally Elmer Centre	106 Daly St.	2,103	187,026	14,139			41,694	0.58
Fire Storage Building	2117 Unity Rd.	491		7,968			15,065	0.62
Forestry Garage	1643 Hwy. 15	802	48,885				3,911	0.22
Public Works Administration Office (Friendship)	141 Railway St.	334	19,890	5,252			11,521	0.82
Totals		153,453	23,977,062	2,274,085	35,654	30,728	6,362,298	0.99

Appendix B – Rooftop Solar PV Electricity Generation (2013)

MicroFIT -- kWh & \$ Generated - 2013															
Building	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year to date		
Artillery Park	439.0	522.00	862.00	1,464.00	1,936.00	768.00	1,484.00	1,715.00	1,513.00	707.00	542.00	153.14	12,105.1		
	\$352.08	\$418.64	\$691.32	\$1,174.13	\$1,552.67	\$615.94	\$1,190.17	\$1,375.43	\$1,213.43	\$567.01	\$434.68	\$122.82	\$9,708.32		
Central Library	265.0	576.0	917.00	1,353.00	1,588.00	594.00	764.00	1,617.00	1,512.00	1,428.00	617.00	383.00	11,614.0		
	\$212.53	\$461.95	\$735.43	\$1,085.11	\$1,273.58	\$476.39	\$612.73	\$1,296.83	\$1,212.62	\$1,145.26	\$494.83	\$307.17	\$9,314.43		
Social Services	510.00	590.00	1,142.00	1,344.00	1,901.00	1219.00	1542.00	1837.00	1391.00	1039.00	464.00	259.44	13,238.4		
	\$409.02	\$473.18	\$915.88	\$1,077.89	\$1,524.60	\$977.64	\$1,236.68	\$1,473.27	\$1,115.58	\$833.28	\$372.13	\$208.07	\$10,617.23		
Kingscourt Library	162.00	387.00	705.00	1,216.00	1,759.00	1,498.00	1,641.00	1,641.00	1,473.00	1,267.00	703.00	283.00	12,735.0		
	\$129.92	\$310.37	\$565.41	\$975.23	\$1,410.72	\$1,201.40	\$1,316.08	\$1,316.08	\$1,181.35	\$1,016.13	\$563.81	\$226.97	\$10,213.47		
Fire Hall 1	349.96	423.27	620.15	1,139.63		1,734.00	1,781.00	2,027.00	1,471.00	1,138.00	597.00	262.00	11,543.0		
	\$280.67	\$339.46	\$497.36	\$913.98	\$0.00	\$1,390.67	\$1,428.36	\$1,625.65	\$1,179.74	\$912.68	\$478.79	\$210.12	\$9,257.49		
Fire Hall 2	153.2	511.38	731.36	1,157.45	2,207.22	1,384.00	1,426.00	1,748.00	1,156.00	1,146.00	623	176	12,419.6		
	\$122.87	\$410.13	\$586.55	\$928.27	\$1,770.19	\$1,109.97	\$1,143.65	\$1,401.90	\$927.11	\$919.09	\$499.65	\$141.15	\$9,960.53		
Fire Hall 3	423.31	456.82	820.72	1,521.59		1,660.93	1,760.00	1,850.00	1,440.00	1,310.00	690.00	340	12,273.4		
	\$339.49	\$366.37	\$658.22	\$1,220.32	\$0.00	\$1,332.07	\$1,411.52	\$1,483.70	\$1,154.88	\$1,050.62	\$553.38	\$272.68	\$9,843.24		
Fire Hall 7	563.98	523.17	709.80	1,036.74	1,479.48		3957.93	1930	1,450.00	1,560.00	1,160.00	530	14,901.1		
	\$452.31	\$419.58	\$569.26	\$831.47	\$1,186.54	\$0.00	\$3,174.26	\$1,547.86	\$1,162.90	\$1,251.12	\$930.32	\$425.06	\$11,950.68		
Fire Hall 8	386.96	536.59	1,198.79	1,467.90	1,925.00	2,893.72	1,654.00	1,900.00	1,925.00	1,593.00	1140.00	613	17,234.0		
	\$310.34	\$430.35	\$961.43	\$1,177.26	\$1,543.85	\$2,320.76	\$1,326.51	\$1,523.80	\$1,543.85	\$1,277.59	\$914.28	\$491.63	\$13,821.64		
Airport Terminal	293.73	286.36	415.26	890.52	775.33	1,637.15	1,460.00	1360	1,340.00	1,020	540		10,018.4		
	\$235.57	\$229.66	\$333.04	\$714.20	\$621.81	\$1,312.99	\$1,170.92	\$1,090.72	\$1,074.68	\$818.04	\$433.08	\$0.00	\$8,034.72		
Madoma Community Centre	250.24	271.75	490.22	937.70	1,363.34	2,616.45	1,853.00	1,877.00	1,518.00	1,189	613	258	13,237.7		
	\$200.69	\$217.94	\$393.16	\$752.04	\$1,093.40	\$2,098.39	\$1,486.11	\$1,505.35	\$1,217.44	\$953.58	\$491.63	\$206.92	\$10,616.64		
													Total kWh	141,319.7	
														Total \$	\$113,338.38
FIT -- kWh & \$ Generated - 2013															
Building	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year to date		
John Counter Blvd. Campus	-	6,985.00	15,404.00	24,228.00	35,632.00	35,629.00	36,175.00	38,008.00	29,325.00	25,251.00	14,884.00		261,521.0		
	\$0.00	\$4,980.31	\$10,983.05	\$17,274.56	\$25,405.62	\$25,403.48	\$25,792.78	\$27,099.70	\$20,908.73	\$18,003.96	\$10,612.29	\$0.00	\$186,464.47		
													Total kWh	402,840.7	
														Total \$	\$299,802.86

Appendix C - Energy Retrofit Program Summary

BUILDING / MEASURE			SAVINGS							COSTS		INCENTIVES		
Bldg # Msr Tag	Building Measure	In/Out	Total Savings (\$)	Electricity Consumption [kWh]	Electricity Demand Peak/Month [kW/kVa]	Annual Electricity Demand [kW/kVa]	Natural Gas [m³]	Energy [GJ]	eCO2 [Tonnes]	Measure Cost w/Tax (\$)	Simple Payback w/Tax [Years]	Total Incentives (\$)	Total Measure Cost w/Incentives (\$)	Simple Payback w/Incentives [Years]
01 - Invista Centre			\$ 50,578	380,685	43.3	519.6	42,118	2,939	122	\$ 446,127	8.8	\$ 26,534	\$ 419,592	8.3
A - LIGHTING RETROFITS & REDESIGN			\$ 23,521	205,960	43.3	519.6	-	741	23	\$ 226,017	9.6	\$ 10,298	\$ 215,719	9.2
A01	Lighting Retrofit & Redesign	out	\$ 2,997	24,542	8.0	95.5	-148	83	2	\$ 46,614	15.6	\$ 1,227	\$ 45,387	15.1
A02	Interior LED	out	\$ 647	5,108	1.9	23.3	-31	17	1	\$ 39,248	60.7	\$ 255	\$ 38,993	60.3
A03	Exterior LED	IN	\$ 8,536	73,791	16.8	202.0	-	266	8	\$ 82,168	9.6	\$ 3,690	\$ 78,478	9.2
A05	Ice Pad Lighting Retrofit	IN	\$ 14,986	132,169	26.5	317.5	-	476	15	\$ 143,849	9.6	\$ 6,608	\$ 137,240	9.2
B - MECHANICAL MODIFICATIONS			\$ 24,658	150,000	-	-	42,118	2,108	97	\$ 213,900	8.7	\$ 15,000	\$ 198,900	8.1
B01	Ice Plant Controls Upgrade	IN	\$ 14,550	150,000	-	-	-	540	17	\$ 110,400	7.6	\$ 15,000	\$ 95,400	6.6
B02	Radiant Slab Heating for Stands	IN	\$ 10,108	-	-	-	42,118	1,568	80	\$ 103,500	10.2	\$ -	\$ 103,500	10.2
C - BUILDING AUTOMATION CONTROLS			\$ 2,398	24,725	-	-	-	89	3	\$ 6,210	2.6	\$ 1,236	\$ 4,974	2.1
C01	AHU Time of Day Scheduling	IN	\$ 2,398	24,725	-	-	-	89	3	\$ 3,450	1.4	\$ 1,236	\$ 2,214	0.9
C02	Controls Recommissioning	IN	\$ -	-	-	-	-	-	-	\$ 2,760	--	\$ -	\$ 2,760	--
D - BUILDING ENVELOPE UPGRADES			\$ -	-	-	-	-	-	-	\$ -	--	\$ -	\$ -	--
D01	Building Envelope Sealing	out	\$ 415	-	-	-	1,730	64	3	\$ 6,303	15.2	\$ 173	\$ 6,130	14.8
02 - Grand Theatre			\$ 12,104	103,943	19.0	228.6	-	374	11	\$ 73,593	6.1	\$ 4,897	\$ 68,696	5.7
A - LIGHTING RETROFITS & REDESIGN			\$ 8,184	63,943	19.0	228.6	-	230	7	\$ 68,901	8.4	\$ 3,197	\$ 65,704	8.0
A02	Interior LED	IN	\$ 6,285	46,599	17.1	204.8	-	168	5	\$ 57,276	9.1	\$ 2,330	\$ 54,946	8.7
A03	Exterior LED	IN	\$ 1,899	17,344	2.0	23.8	-	62	2	\$ 11,626	6.1	\$ 867	\$ 10,758	5.7
C - BUILDING AUTOMATION CONTROLS			\$ 3,920	40,000	-	-	-	144	4	\$ 4,692	1.2	\$ 1,700	\$ 2,992	0.8
C01	AHU Time of Day Scheduling	IN	\$ 3,920	40,000	-	-	-	144	4	\$ 4,692	1.2	\$ 1,700	\$ 2,992	0.8
03 - British Whig			\$ -	-	-	-	-	-	-	\$ -	--	\$ -	\$ -	--
A - LIGHTING RETROFITS & REDESIGN			\$ -	-	-	-	-	-	-	\$ -	--	\$ -	\$ -	--
A01	Lighting Retrofit & Redesign	out	\$ 1,189	8,414	3.4	41.3	-	30	1	\$ 24,267	20.4	\$ 421	\$ 23,846	20.1
A03	Exterior LED	out	\$ 836	6,815	1.6	18.7	-	25	1	\$ 11,430	13.7	\$ 341	\$ 11,089	13.3
D - BUILDING ENVELOPE UPGRADES			\$ -	-	-	-	-	-	-	\$ -	--	\$ -	\$ -	--
D01	Building Envelope Sealing	out	\$ 285	-	-	-	839	31	2	\$ 9,668	33.9	\$ -	\$ 9,668	33.9
04 - K-Rock Centre			\$ 8,158	68,349	5.4	65.1	2,448	337	12	\$ 82,042	10.1	\$ 6,162	\$ 75,880	9.3
A - LIGHTING RETROFITS & REDESIGN			\$ 2,375	18,349	5.4	65.1	-	66	2	\$ 29,740	12.5	\$ 917	\$ 28,823	12.1
A01	Lighting Retrofit & Redesign	IN	\$ 1,989	15,193	4.7	56.5	-	55	2	\$ 28,541	14.4	\$ 760	\$ 27,782	14.0
A02	Interior LED	out	\$ 14,950	107,745	41.6	499.2	-	388	12	\$ 303,570	20.3	\$ 5,387	\$ 298,183	19.9
A03	Exterior LED	IN	\$ 387	3,156	0.7	8.6	-	11	0	\$ 1,199	3.1	\$ 158	\$ 1,041	2.7
B - MECHANICAL MODIFICATIONS			\$ 4,950	50,000	-	-	-	180	6	\$ 41,400	8.4	\$ 5,000	\$ 36,400	7.4
B01	Ice Plant Controls Upgrade	IN	\$ 4,950	50,000	-	-	-	180	6	\$ 41,400	8.4	\$ 5,000	\$ 36,400	7.4
C - BUILDING AUTOMATION CONTROLS			\$ -	-	-	-	-	-	-	\$ -	--	\$ -	\$ -	--

BUILDING / MEASURE			SAVINGS							COSTS		INCENTIVES		
Bldg # Msr Tag	Building Measure	In/Out	Total Savings (\$)	Electricity Consumption (kWh)	Electricity Demand Peak/Month (kW/kVa)	Annual Electricity Demand (kW/kVa)	Natural Gas (m³)	Energy (GJ)	eCO2 (Tonnes)	Measure Cost w/Tax (\$)	Simple Payback w/Tax (Years)	Total Incentives (\$)	Total Measure Cost w/Incentives (\$)	Simple Payback w/Incentives (Years)
C01	AHU Time of Day Scheduling	out	\$ 8,368	84,530	-	-	-	304	9	\$ 6,900	0.8	\$ 2,500	\$ 4,400	0.5
C02	Controls Recommissioning	out	-	-	-	-	-	-	-	\$ 6,900	--	-	\$ 6,900	--
C03	BAS Integration	out	-	-	-	-	-	-	-	\$ 16,491	--	-	\$ 16,491	--
D - BUILDING ENVELOPE UPGRADES			\$ 832	-	-	-	2,448	91	5	\$ 10,902	13.1	\$ 245	\$ 10,657	12.8
D01	Building Envelope Sealing	IN	\$ 832	-	-	-	2,448	91	5	\$ 10,902	13.1	\$ 245	\$ 10,657	12.8
Program Total			\$ 70,840	552,977	67.8	813.2	44,566	3,650	146	\$ 601,762	8.5	\$ 37,594	\$ 564,169	8.0

Notes: