
CITY OF KELOWNA

MEMORANDUM

Date: March 31, 2008
File No.: 0970-08
To: City Manager
From: Civic Properties Manager
(with Civic Properties Projects Supervisor and Works and Utilities Water Manager)
Subject: Energy/Carbon Management Plan for Civic Properties

RECOMMENDATION:

THAT Council receive the attached Energy Management Plan as information as attached to the report from the Civic Properties Manager dated March 31, 2008;

AND THAT the 2008 Financial Plan be amended to reflect the reallocation of \$502,500 in the Civic Properties 2008 Capital Plan (Rutland Arena Light Upgrade, PRC Solar Hot Water) funded from internal reserves to implement phase one of the Energy Management Plan as detailed in this report;

AND THAT Civic Properties return to Council annually with an update to the Plan documenting the 2007 utility baseline, the results achieved and further opportunities, in a reporting format acceptable to the Province under the BC Climate Action Charter, beginning after one full climate cycle and prior to Council's 2010 Budget deliberations;

AND THAT Civic Properties submit additional substantiated Capital Budgets in subsequent years to meet Kelowna's full commitment under the BC Climate Action Charter by 2012;

AND THAT Civic Properties return to Council with further information regarding Human Resource Implications in conjunction with recommendations regarding the operating contract for the new Mission Recreation Park Aquatic Center;

AND THAT all future Capital Budget submissions include a report on carbon impacts and how any additions in GHG emissions will be offset, where applicable;

AND FURTHER THAT the Energy Management Plan be submitted as evidence of the City's commitment to the BC Climate Action Charter and to the BC Green Cities Awards 2008 competition.

BACKGROUND:

Kelowna has embarked on an aggressive 'green' agenda

Kelowna has endorsed 'energy management' and 'carbon neutrality' as two important objectives with the goal of reducing both (a) energy consumption and (b) the environmental and climate change

impacts of facility operations. Council has shown its support for energy and greenhouse gas emissions in buildings through many initiatives that include:

- creating a staff Energy Management Committee (1994),
- endorsing the "BC Climate Action Charter" which commits Kelowna to achieving a 20% reduction in GHG emission from 2007 levels by 2012,
- approving energy conservation enhancements at the Mission Recreation Park Aquatic Facility which resulted in a calculated GHG savings of 850 tonnes/year,
- establishing a Sustainability Working Group with pertinent mandates (August 2007) to:
 - reduce water consumption by 15% in buildings by 2012
 - develop, by July 2008, an Action Plan for achieving a 20% reduction in corporate greenhouse gas emissions
 - support the work of the BC Solar Roofs Roadmap Project Committee and identify opportunities for Kelowna becoming a solar city (in this regard, Kelowna received a \$1M outdoor solar lights project from Natural Resources Canada and Carmanah Technologies, announced at Globe 2008 in Vancouver on March 13, 2008),
- approving the Civic Properties 2008 Financial Plan objective of implementing a comprehensive Energy Management Plan for city-owned buildings.

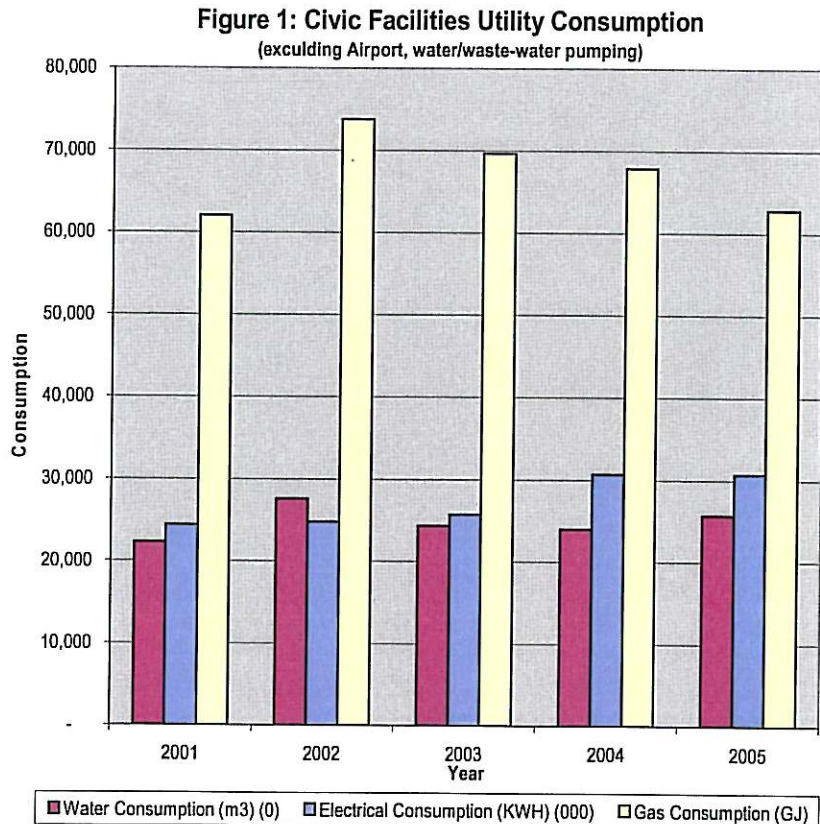
Civic Properties Utility Consumption and Green House Gas emissions is significant

On behalf of the City, the Civic Properties Division 'owns' approximately 120 buildings totaling 1,575,000 square feet with an insured current replacement value of \$191.431,000. In 2005, \$2,315,305 was spent on electricity, gas and water utility consumption

The trends in utility consumption for Civic Properties facilities are illustrated in Figure 1. Between 2002, when the Capital News Centre was connected to utilities and 2005, there was a 7% decrease in water consumption, a 24% rise in electrical consumption and a 15% decrease in natural gas consumption, showing that some improvements, primarily in natural gas-burning equipment, have already been introduced over the last few years.

The Plan will achieve Civic Properties obligations under the BC Climate Action Charter

The attached plan (Annex 3) partially satisfies the commitments of the Sustainability Working Group to achieve a 20% reduction in current GHG emissions from



city-owned facilities. This initiative is limited to facilities under the responsibility of Civic Properties and therefore excludes the Airport and all utility process facilities (water pumping, waste-water processing, and sewage lift stations, with the exception of the Wastewater Treatment Administration building). It provides for a phased achievement of 1002 tonnes of GHG emission reduction/ for a total investment of \$1.351M, yielding an estimated utility savings of \$407,000 with a simple payback of 3.3 years¹. The following estimates outline the scope of the plan:

Table 1: Proposed Utility Savings in City-owned buildings

UTILITY	CURRENT CONSUMPTION	CURRENT COST	PROJECTED CONSUMPTION REDUCTION	%
Electricity	30,694,807 kWh/yr	\$1,535,000/yr	5,368,701 kWh	18%
Gas	64,780 GJ/yr	\$679,542/yr	13,794 GJ	21%
Water	259,033 m ³ /yr	\$82,849/yr	35,520 m ³	14%
TOTAL		\$2,315,305/yr		

This plan, if implemented, would be sufficient to meet the commitments that Kelowna has made as a signatory to the BC Climate Action Plan provided that the GHG emissions added through new

construction are less than 1002 tonnes. The Mission Recreation Park Aquatic Centre was originally designed to produce about 1605 tonnes of GHG emissions. The 20% reduction proposed in this plan would have been needed to offset the GHG emitted by this single facility. Fortunately, Council approved a bundle of energy and environmental enhancements that reduced the anticipated GHG emissions of the Aquatic Centre to 755 tonnes/yr (a reduction of 850 tonnes). This leaves only 247 tonnes of carbon credits in Kelowna's account that can be used against future new buildings.

All new facilities commissioned after January 1, 2008 will enlarge Kelowna's carbon footprint, unless offsetting initiatives are implemented simultaneously

New buildings will be inevitable in the provision public services to a growing population. For instance, the additions to the Airport currently under construction and the planned Wastewater Treatment Plant will make significant additions to the City's carbon footprint. It is recommended therefore, that a budget submission for all new buildings or building expansions to be built and occupied after January 1, 2008 be accompanied by a plan that shows the new carbon emission impacts of the new facility, and how this addition will be offset.

The "energy management plan" includes both operational improvements and technological upgrades

The plan was developed through the following steps:

1. Based on actual energy consumption figures for 2002-2006, the utility consumption of City-owned buildings was compared to similar buildings (Building Energy Performance Index-BEPI).
2. The dozen buildings with the highest potential \$-savings were audited through contributions from FortisBC and Terasen Gas
3. Key energy savings opportunities have been identified in this plan, some of which can be implemented immediately, while others will require further engineering analysis and economic modeling.

The plan outlines steps toward comprehensive utility consumption reduction. There are two categories of energy strategies: **operational improvements** and **technological upgrades**. Initially,

¹ This plan is based on 2005 utility consumption figures. The implementation of the Agresso financial software has diverted human resources so that 2007 figures are not yet available. Although significant changes to the data are not expected, adjustments to the plan will be made to accommodate any identified changes.

for each dollar invested, *operational improvements* can yield much greater reduction in GHG emissions and energy consumption than *technological enhancements*. When employed, *technological enhancements* yield the best return on investment when equipment is replaced at the end of its service life. Since a replacement cost would be incurred at this time anyway, the net cost to upgrade the equipment yields very favourable payback periods. The plan also notes that the lowest costs for *technological enhancements* occur when the facility is built and not as a retrofit to an existing building.

Table 2: Summary of Energy Management Plan Strategies

Strategy	Description	% of anticipate utility savings	\$ invested per tonne GHG reduction	Savings Payback Period (yrs)
Operational Improvements				
1.1	Controls	10%	\$519	0.8
1.2	Commissioning	4%	\$760	1.2
1.3	Training	enabling	see 1.1&1.2	n/a
1.4	Awareness	enabling	see 1.1&1.2	n/a
Technological Enhancements				
2.1	Replacement of Spent equipment	up to 6%	\$882	4.3
2.2a	Electrical upgrades	up to 6%	\$8,095	9.4
2.2b	Gas upgrades	up to 6%	\$2,862	10.0
2.2c	Solar upgrades	up to 6%	\$2,324	15.0

The implementation of the plan begins in 2008 by reallocating the capital budget (\$502,500) already assigned to Civic Properties out of internal reserves. The intent is to repay these reserves through energy savings and then to re-invest those reserves into future projects as the reserves are replenished. The total reserves dedicated to energy conservation initiatives

could be increased in the future based on a detailed rationale subject to Council approval. The reallocation of funds follows:

Table 3: Investments in initial energy conservation projects (see details in Annex 3)

Strategy	Cost Saved	Capital Cost	Payback (yrs)	GHG reduction	\$/T
Controls	\$30,490	\$47,600	1.6	91.7 T	\$519
Commissioning	\$114,248	\$137,098	1.2	180.4 T	\$760
Upgrades at end of service life	\$23,696	\$202,000*	4.3	115.7 T	\$882
Water	\$12,787	\$65,000	5.1	0.3 T	\$203,125
TOTALS	\$181,221	\$451,698	1.9*	388.1 T	\$901

* The net cost of "technology upgrades at end of service life" is \$102,000 which is the difference between upgrading worn-out equipment with equipment providing higher energy efficiency vs. replacing the worn-out equivalent with equipment of similar performance. The net cost was used to calculate the payback period since a basic replacement cost was going to be incurred anyway.

The "training" and "awareness" shown in Table 2 would be financed from existing Divisional operational budgets. The difference between the capital cost shown and the actual \$502,500 budget will be used for contingencies, or additional work.

These initial investments will result in over 1/3 of the targeted 20% reduction in Civic Properties' GHG emissions. Additional budgets in future years will be required to meet the full target. The final distribution of investments against strategies follows:

Table 4: Total investments to achieve the 20% reduction in GHG emissions (see Annex 3)

Strategy	Electricity Saved	Gas Saved	Cost Saved	Capital Cost	Payback (yrs)	GHG reduction	\$/T
Controls	3,069,480 kWh	6,478 GJ	\$221,444	\$260,019	1.2	501.0 T	\$519
Commissioning	1,227,792 kWh	2,591 GJ	\$82,570	\$104,319	1.3	201.0 T	\$519
Technology Upgrades	1,071,429 kWh 20% of capital costs	4,725 GJ 80% of capital costs	\$103,136	\$987,000	9.6	300.0 T	\$3,290
ENERGY	5,368,701 kWh	13,794 GJ	\$407,150	1,351,338	3.3	1002.0T	\$1,347
Water			\$12,787	\$65,000	5.1	0.3 T	\$203,125
TOTALS			\$422,637	\$1,416,338	3.2	1002.3T	\$1,413

Since the initial phase spending ½ million dollars will pluck low-hanging fruit, the cost/tonne of saved GHG emission will become more expensive as the plan unfolds.

The on-going challenge will be changing the way we think!

Reducing total energy consumption and the environmental impacts of what we do will require that new results be measured in addition to initial cost-effectiveness and customer satisfaction. These environmental stewardship accountabilities will require tracking and monitoring new data-bases, providing new reports to Council and the public, analyzing and acting on any performance shortfalls, and improving a culture of interdepartmental cooperation.

The calculation of carbon footprints and mitigation strategies is in its infancy and is likely to become more refined over time. Strategies will need to adjust to the maturation of scientific knowledge regarding climate-change.

INTERNAL CIRCULATION TO:

Civic Properties Projects Supervisor
 Chair, Energy Management Committee, Manager Water & Drainage Manager
 Financial Planning Manager
 Coordinator, Sustainability Working Group
 A/Director, Human Resources
 Urban Forestry Supervisor
 Development Manager, RPCS

Civic Properties has also provided a copy of this report to the Waste Water Manager and to the Acting Airport General Manager with an offer of assistance to help other internal facility owners manage energy and greenhouse gas emissions.

LEGAL/STATUTORY AUTHORITY:

In addition to 'carbon neutrality' by 2010, the Provincial government has committed, in law, to a 33% reduction in GHG by 2020 and an 80% reduction by 2050, relative to 2007 levels. Local governments, as signatories to the Climate Action Charter, are committing to 'carbon neutrality' by 2012.

EXISTING POLICY:

Council has endorsed the importance of energy management and carbon emission reduction through several initiatives, including:

- Council endorsed the "BC Climate Action Charter" with over 60 other local governments on September 26, 2007. The signatories, now totaling 95, agreed to develop strategies and take actions to become carbon neutral in respect of their operations by 2012.
http://www.cserv.gov.bc.ca/ministry/whatsnew/climate_action_charter.htm

- The Energy Management Committee was mandated to achieve utility reductions and seek opportunities to achieve increasingly sustainable buildings (<http://www.kelowna.ca/CM/Page887.aspx>)
- Council has endorsed the action plan for the Sustainability Working Group which includes short-term actions to reduce GHG emissions (August 14, 2007 Report to Council, <http://www.kelowna.ca/CM/Page1338.aspx>)

FINANCIAL/BUDGETARY CONSIDERATIONS:

The 2008 Capital Budget approved \$502,500 from internal reserves for Energy Conservation Projects based on previous individual building studies. Based on more current and comprehensive work reflected in the Energy Management Plan, it is recommended that the funding be reallocated to the first phase of the implementation of this Energy Management Plan (see Table 3) and that energy savings be tracked and reported on an annual basis.

PERSONNEL IMPLICATIONS:

Operational improvements will be achieved through

- installation, programming, monitoring and operation of new control strategies
- on-going performance commissioning as well as the installation, programming and monitoring of controls equipment, and the improved maintenance of utility consuming equipment, fixtures and fittings.

This will require additional staff in the HVAC and Electrical trades, but the full rationale for this position will be developed in conjunction with resource requirements for the upcoming maintenance responsibilities on the Mission Recreation Park Aquatic Facility.

EXTERNAL AGENCY/PUBLIC COMMENTS:

Terasen Gas and FortisBC are partners in the Energy Management Committee and will assist in identifying grants and rebates earned through the completion of this work.

ALTERNATE RECOMMENDATION:

There are alternate strategies for GHG emission reductions:

- reduction of local GHG emissions
- provision of carbon sinks (e.g. urban forests) to increase the long-term capture and storage (sequestration) of GHG emissions
- purchase of carbon credits

This report and the Energy Management Plan favour the first approach.

Increasing the size of our urban forest is however, a viable local option for increasing carbon sinks. Trees capture about 2.5kg of carbon each year until they reach full growth at 80-100years; it would take about 400 trees to sequester 1 metric tonne (see http://www.treecanada.ca/publications/pdf/english_reduceco2.pdf). The Urban Forests Effect Model (UFORE) calculations indicate that Kelowna's entire tree canopy is sequestering about 7,500 metric tonnes of carbon per year. To qualify as GHG saved, however, the mature tree would have to be harvested and converted to a durable product; if it was burned, or left to rot, the sequestered carbon would be returned to the atmosphere with no net GHG savings. At a cost of \$2/seedling or \$350/mature tree, the investment per tonne sequestered would range from \$800-\$140,000. Planting mature trees advances the time when the full potential of carbon sequestration is available. Trees do, however, have important symbolic value. Civic Properties will partner with Parks to plant and identify specimen trees at the site of key energy management projects, and to plant and identify new urban forests dedicated to the sequestration of carbon emissions from City-owned buildings. Records of the carbon credits planted in urban trees/forests will be maintained according to emerging standards from the Federation of Canadian Municipalities.

The purchase of carbon credits to offset Kelowna's corporate production of GHG emissions is not recommended at this time.

The production of 'green energy' to replace natural gas, however, will be the subject of a future report to Council.


COMMUNICATIONS CONSIDERATIONS:

It is recommended that the Energy Management Plan form part of the 2008 submission to the BC Green Cities Awards 2008 competition.

Considerations that were not applicable to this report:

**LEGAL/STATUTORY PROCEDURAL REQUIREMENTS:
TECHNICAL REQUIREMENTS:**

Submitted by:



R. Cleveland, Civic Properties Manager

Approved for Inclusion:



Cc: Martin Johansen, Projects Supervisor
Don Degen, Chair, Energy Management Committee, Manager Water & Drainage Manager
Keith Grayston, Financial Planning Manager
Signe Bagh, Coordinator, Sustainability Working Group
Charlene Covington, A/Director, Human Resources
Ian Wilson, Urban Forestry Supervisor
Sam Samaddar, Acting Airport General Manager
Bill Berry, Wastewater Manager

ANNEX 1: CARBON NEUTRALITY (see www.townsfortomorrow.gov.bc.ca/esamples.html)

The BC Government has published (latest edition – February 20, 2008) a *Greenhouse Gas Emission Assessment Guide for BC Local Governments* to support:

- completing infrastructure grant applications and program reporting requirements
- achieving *BC Climate Action Charter* commitments, and
- encouraging energy efficiency, renewable energy production, and other greenhouse gas reduction projects.

In addition to providing an overview of climate change from a local government perspective, it provides high-level calculation methodologies. Local governments have direct influence over about 45% of BC's GHG emissions (carbon dioxide, methane & nitrous oxide) through its own operations (fleet, buildings, and utility operations) and through land use and infrastructure regulations that affect transportation (38% of total emissions), building performance (11% of total emissions), and waste management (8% of total emissions)². This "Guide" is expected to evolve over time as issues of calculation and climate change impact become better understood.

Carbon neutrality, for purposes of the Climate Change Charter, means that local governments "will emit no net GHG emissions from local government operations." Our understanding is that by 2012, the total GHG emissions will be no greater than those emitted in 2007, requiring clear documentation about the base year. The Province has gone beyond that, having legally committed to a further 33% reduction by 2020 and an 80% reduction by 2050. There are two basic strategies:

1. reduce total emissions to offset the new emissions introduced from new projects and new growth in either "absolute" or "relative" terms.
2. buy carbon credits to offset "net" carbon additions or augment carbon 'sinks' to sequester the excess carbon emissions

The Civic Properties plan considers only strategy 1 (emission reductions), that can be generally achieved as follows:

1. **Absolute** reductions are achieved by retrofitting existing facilities to reduce GHG emissions from previous 'actual' emissions
2. **Relative** reductions are achieved by building new facilities that produce GHG emissions at a rate less than that calculated for a similar building built to the minimum current energy codes. The 'baseline' for the new building would be that calculated by code compliance. The "guide" suggests, therefore, that a new building that produces 50% less GHG emission than mandated by code would still add to the total GHG emissions and in itself would not be carbon neutral (the alternative interpretation is that the *relative* reduction can be used to offset the actual GHG emission and the project is carbon neutral --- clarification to be sought from the Province).

Since carbon neutrality is defined as no net additional GHG emissions, it is better to reduce emissions from existing building rather than to build new energy efficiency buildings, unless those new buildings are highly energy efficient, or operated with renewable energy sources. Where new construction is necessary, though, it is important to see development holistically. For instance, the location and design of a new building in conjunction with a bus route or cycle path could result in a significant

² Buildings account for over 30% of total Energy consumption. The use of hydro-electric power results in the buildings accounting for a lower proportion (11%) of GHG emissions, although hydro dams have their own significant environmental impacts. The Civic Properties energy management plan retains the balanced objective of energy (gas & electricity) consumption reduction for both economic and environmental reasons, although the reduction of electrical consumption contributes less to climate change initiatives.

reduction in transportation-related GHG emissions, which when calculated together could result in a net reduction of GHG for the project as a whole. The calculation would be further improved through the addition of urban forests. This also suggests that rapidly growing communities will be required to grow smarter (transit oriented development, compact livable communities, etc) than communities that can simply retrofit old infrastructure in a no growth environment.

The basic emissions calculator follows (It is noteworthy that the "Guide" quotes work done in Kelowna, specifically energy upgrades at the PRC, as a case study in calculating GHG reductions):

Fuel	GHG factor	Common conversions
Electricity	0.0000022 tCO ₂ e/kWh	1kWh = 0.0036 GJ (The GHG factor will change with the relative contributions of fossil-fuel-fired electric generation in the grid power mix)
Nat'l gas	0.051 tCO ₂ e / GJ	1 GJ = 26.9m ³ – 949 cubic feet = 0.948 million BTUs
Gasoline	0.00241 tCO ₂ e / litre	1 litre = 0.220 imp. gallons – 0.265 US gallons
Diesel	0.00276 tCO ₂ e / litre	See gasoline

ANNEX 2: BEPI STUDY OF CITY-OWNED BUILDINGS

Utility Consumption Savings (potential): Civic Properties Building Inventory

Data Source: Interior Mechanical Consultants, July 28, 2007

Prepared 07.07.29

GREATEST POTENTIAL IMPROVEMENT BY % \$ SAVED, THEN TOTAL \$ SAVINGS

Facility	Area	% Savings	\$ Savings	\$saved/sf
Fire Hall - Rutland	1,382	50	\$7,951	
"Y" (Athans Pool)	28,911	35	\$74,974	
Library - Main	38,706	30	\$33,782	
Parks - Admin Building	3,500	30	\$5,064	
Parks - Maintenance Building	800	30	\$3,702	
Fire Hall - SE Kelowna	3,252	30	\$2,609	
Community Police Station-Mission	1,851	30	\$1,549	
Fire Hall - McKinley	1,441	30	\$962	
Fire Hall - Enterprise	25,554	25	\$15,768	
Laurel Packinghouse	4,159	25	\$4,300	
OK Mission Community Hall	2,402	25	\$2,511	
Fire Hall - OK Mission	3,308	25	\$1,940	
Fire Hall - Glenmore	3,252	25	\$1,794	
	118,518		\$156,906	\$1.32

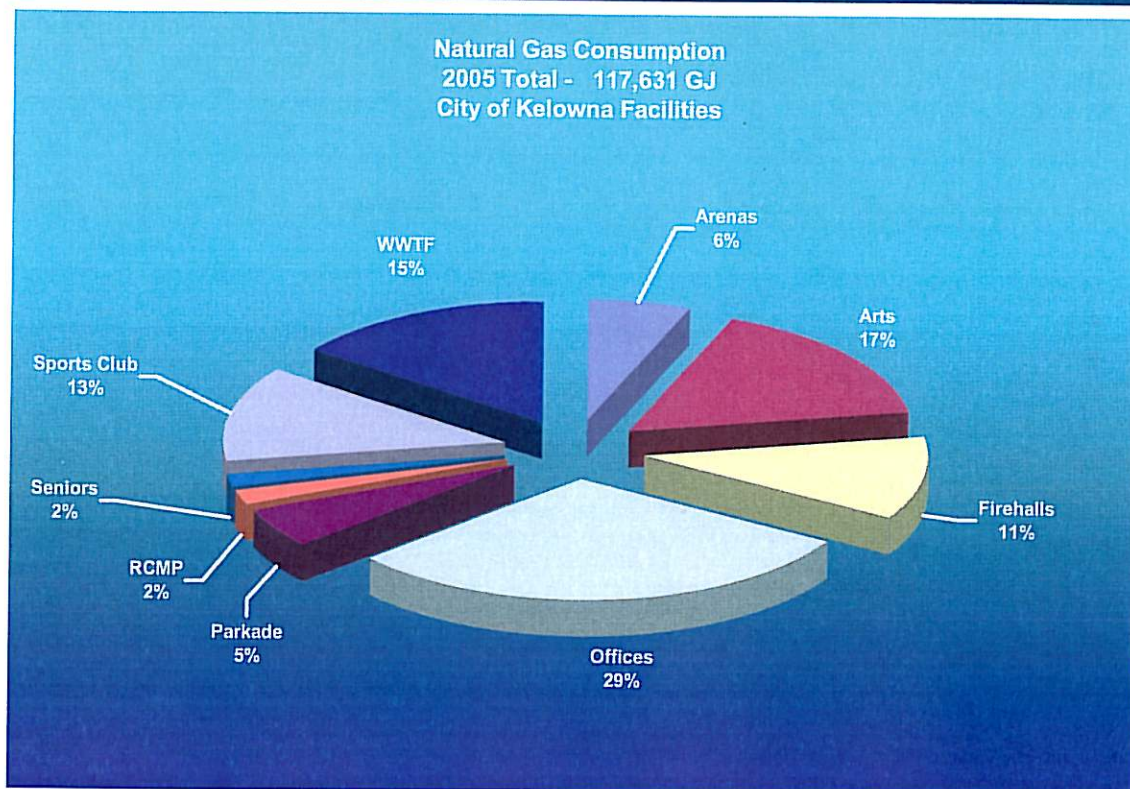
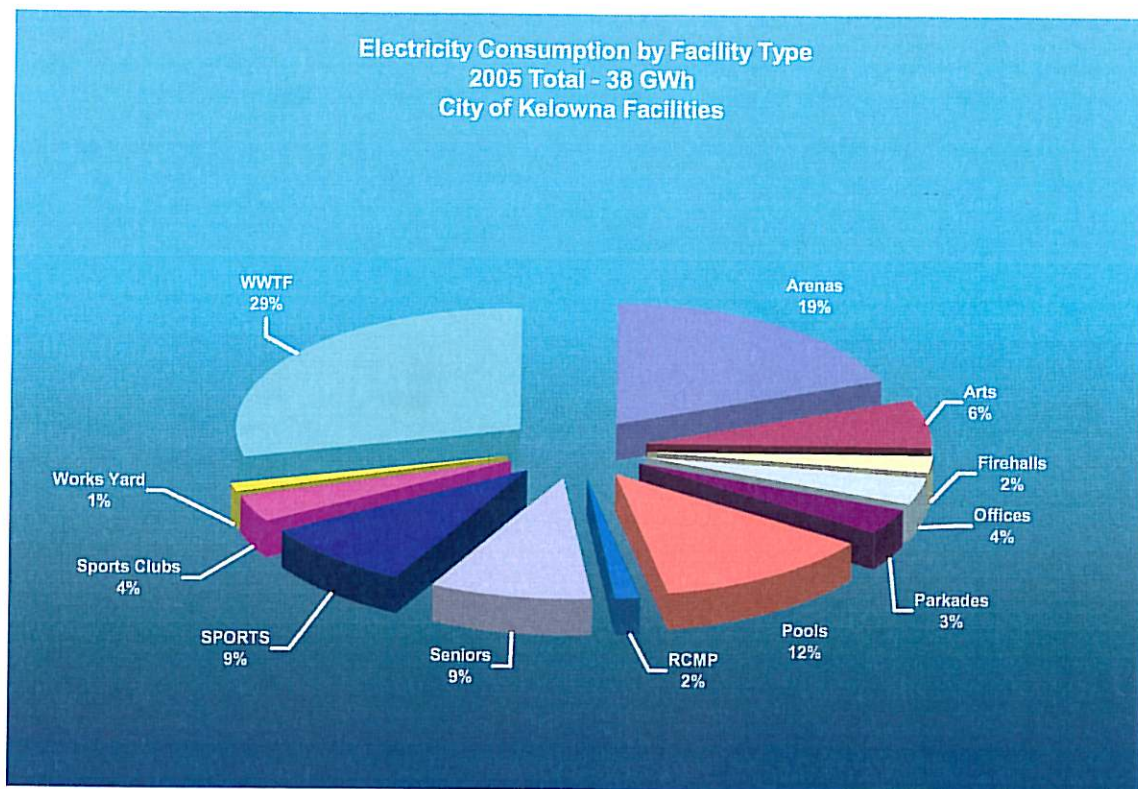
COMPARISON TO GREATEST TOTAL \$ SAVINGS

Facility	Area	% Savings	\$ Savings	
"Y" (Athans Pool)	28,911	35	\$74,974	
Wastewater Treatment Facility	13,100	10	\$66,947	
Capital News Centre	195,908	18	\$53,913	
Rutland Twin Arenas	68,836	20	\$35,848	
Library - Main	38,706	30	\$33,782	
Mission Recreation Park	100,000	7	\$26,360	
Fire Hall - Enterprise	25,554	25	\$15,768	
Prospera Place	118,158	5	\$14,217	
Memorial Arena	43,260	15	\$12,108	
City Hall	73,242	10	\$11,006	
Fire Hall - Rutland	1,382	50	\$7,951	
Parkinson Recreation Centre	52,629	5	\$7,930	
City Yards	39,219	10	\$7,920	
	798,905		\$368,724	\$0.46

Highlighted rows	Facilities appearing on both lists
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Analysis: As a group, the Fire Halls under-perform relative to similar buildings in the North American sample performing under similar conditions. Fortunately many of the poor performers are relatively small, so they do not have a significant economic impact. Therefore, Civic Properties has focused on the buildings that have the highest potential for economic savings. Note that four of the buildings on this later list also appear on the list of poorest performing buildings.

A preliminary analysis of energy consumption for Kelowna's City-owned buildings (excepting the CNC) was generated from utility consumption data provided by energy suppliers. Illustrations like this provide preliminary focus that needs to be followed up with more detailed analysis as provided through the BEPI study.



ANNEX 3:
City of Kelowna
Energy Management Plan



By Martin Johansen, Civic Properties Projects Supervisor

TABLE OF CONTENTS

Section	Description	Page
	Executive Summary	3
1	Introduction	4
2	Energy management Plan	5
2.1	Phase 1	5
2.2	Phase 2	7
3	Cost Summary of Energy management Plan Initiatives	10
4	Water Management Plan	11
5	Breakdown of Costs to Achieve 20% Reduction of GHG Emissions	12

Executive Summary

The economic and environmental impact stemming from the utility consumption of the City of Kelowna is considerable and as a result the City has adopted utility reduction targets to show leadership in sustainability. These targets are:

1. Achieve a 15% reduction in water consumption in City buildings and operations by 2012.
2. Develop, July 2008, an action plan for achieving a 20% reduction in corporate greenhouse gas emissions in all existing and planned City facilities by 2011.

This report contains an outline of an overall energy management strategy c/w estimated costs for achieving these results. Further planning as well as additional engineering and design development will be required to select the best energy management opportunities available.

The City of Kelowna has the following energy use statistics:

Electrical Energy:	30,694,807 kWh/y
Gas Energy:	64,780 GJ/y
Water Consumption:	259,033 cubic meters/y
GHG Emissions:	5009 metric tonnes

Electrical Cost:	\$1,534,740/y
Gas cost:	\$679,542/y
Water Cost:	\$101,023/y
Utility cost:	\$2,315,305/y

A summary of energy and utility cost saving projected in this report are as follows:

Natural gas saved:	13,794 GJ (21%)
Electrical kWh saved:	5,368,701 kWh (18%)
Water saved:	35,520 cubic meters (14%)

Estimate of retrofit costs:	\$1,351,338
Utility cost savings:	\$407,150
Simple payback:	3.3 years
GHG reduction:	1002 metric tonnes (20%)

Based on these results the GHG and water use reduction targets set by the City of Kelowna are achievable through the steps identified in this Energy Management Plan.

1 Introduction

The Civic Properties in conjunction with the Energy Management Committee are working together to develop an Energy Management Plan for the City of Kelowna. The key deliverables of this plan include:

- Identification of an overall strategy to reduce utility consumption through clearly defined actions which will achieve a 20% reduction of GHG emissions by 2011, a 15% reduction in water usage by 2012.
- An estimate of the financial impact to achieve these results in terms of overall costs and expected operational savings.
- A list of action items that can be implemented immediately as well recommendations where further investigation is required.

The first phase of this process was the completion of a benchmark audit for Civic facilities operated by the City of Kelowna in which BEPI (Building Energy Performance Indices) values were calculated. This analysis provided a list of building which were considered in-efficient energy users and had the greatest potential for utility consumption savings.

The second phase was a walkthrough energy audit and energy analysis of the top ten energy use facilities. The scope of the walk through audit included:

- Description of building and building systems, including the physical plant, equipment and operating conditions.
- Building energy balance, including electric, gas and water.
- Opportunities for operational changes.
- Opportunities for energy conservation measures and reducing maintenance costs, including, improvements in lighting, motors, HVAC, building envelope, domestic hot water and water use.
- Opportunities for solar water heating.

The third phase was a comprehensive review of the reports by City staff with expertise in facility maintenance and operations. The reports were critiqued for accuracy of system description and operational assumptions. Energy retrofit recommendations were assessed and prioritized on a cost/benefit analysis. A list of Energy Management Opportunities was then compiled for each facility.

The final phase was the development of an Energy Management Plan based on analysis of all the data available and input from Civic Properties key personnel with Building Engineering expertise.

2 Energy Management Plan

2.1 Phase 1

The first phase of the Energy Management Plan is focused around how and when we use energy. The four strategies employed in this phase should be implemented immediately in all Civic building as the first stage of the Energy Management Plan. It is estimated these initiatives will result in an overall reduction of energy consumption of 14%. They are as follows:

1. Turn off equipment when it is not needed. This includes lighting, pumps, fan motors, furnaces, chillers etc. When this equipment is off there is no energy being consumed or wasted. Control strategies include motion detectors and photo cells for lighting, DDC and programmable thermostats for scheduling off times and night setbacks and zoning of large spaces so single occupants do not require the whole building to be conditioned. It is estimated this Energy Management strategy alone will reduce energy consumption in City buildings by 10% alone.
2. Post occupancy commissioning and ongoing maintenance. The most critical factor in achieving energy efficiencies is operating equipment within the design parameters of the engineer who designed the system and operating specific equipment within the design operating conditions specified by the manufacturer. Today's buildings are becoming ever more complicated due to their energy efficient designs and as a result need highly skilled people to make sure these systems perform and continue to perform at the levels expected. These designs come at a premium cost and due to their complexity need continual monitoring in order for them to realize the energy savings they were design to achieve. It is estimated this Energy Management strategy will reduce energy consumption in City buildings by a further 4%.
3. The third strategy is staff education. Operational staff working in Civic facilities can significantly impact the energy use profiles for these operations. Our Waste Water and Recreational facilities are the largest energy users in the City of Kelowna and it is imperative the people operating these facilities understand how much energy can be wasted through in-efficient operation. A comprehensive educational program will allow the operators to identify where energy savings opportunities are and to recognize when systems are not operating properly and get repairs/adjustments made.
4. The fourth strategy is based around communication and demonstration of energy management upgrades. Most of the energy management initiatives are not obvious and can give the impression nothing is being done to reduce energy consumption and GHG emissions. Planting of trees and installation of solar lighting along pathways and transit stops are excellent ways to demonstrate and promote awareness in the community that sustainability through energy management is a priority for the City of Kelowna. While these types of initiatives

may have lower GHG reduction potential, their importance lies as a communication tool to demonstrate the City's sustainability objectives.

The following table is a cross section of energy saving initiatives that would be included in phase 2.1.1 of the Energy Management Plan.

Description	Costs	Reduction of GHG in Tonnes	Savings	Simple payback
Rutland Arena lighting control revisions	\$20,000	2.6	\$2600	8
Rutland Arena infiltration control	\$3000	6	\$1300	2.2
Rutland Arena low flow water	\$7500	18	\$3960	2
Rutland Arena de-humidifier control	\$5000	56	\$10,600	.5
Yards DDC controls	\$2000	2.6	\$2000	1
#3 Fire Hall photocells	\$600	.5	\$600	1
Library fan control	\$4000	5	\$8430	.5
Community theatre commissioning	\$5500	1	\$1000	5

Estimated Retrofit Costs:	\$47,600
GHG Reduction:	91.7 tonnes
Savings:	\$30,490
Average Simple Payback:	1.56 years

This equates to an overall average investment of \$519/tonne GHG emission

2.2 Phase 2

The second phase of the Energy Management Plan is focused on technological upgrades. There are four strategies included in this phase and the components they all have in common are engineered design, business cases analysis and life cycle costing. These energy management opportunities are more expensive to implement but will be required for the City of Kelowna to achieve targets for GHG emissions and water conservation.

1. A comprehensive retrofit program which identifies energy management opportunities within existing facilities and schedules those upgrades to take place when existing equipment has reached the end of its service life. This approach reduces the overall payback because the actual cost of the energy saving measures is the incremental cost of these measures over the cost to simply replace the existing equipment and systems with new equipment of the same type. The original equipment was past its service life and needed replacing as a matter of asset preservation. This strategy can be as simple as replacing standard furnace with a condensing furnace or as complicated as replacing an entire pool heating and ventilation system with mechanical dehumidification which was done at PRC in 2004.
2. Identify where standalone energy management opportunities and are not being taken advantage of. An example of this would be where a heat exchanger was installed at Rutland Arena to re-capture discharge superheat from the ammonia compressors to pre-heat DHW for the facility. The result was a decrease in natural gas consumption.
3. As part of any building renovation or expansion include an overall building energy assessment as part of the project. This is a good time to assess all the energy management opportunities in the building and try to incorporate them into the project. Above all it is critical to make sure the existing systems are not compromised and made in-efficient because of the renovation or expansion. This has happened in the past with City Hall for example, where an additional floor was added but the HVAC system was not upgraded to account for the larger space conditioning requirements. The money saved not upgrading the HVAC system during the addition of the fourth floor has been spent many times over in excessive energy costs. Another impact of this has been poor air quality in the building.
4. Incorporate energy management strategies in all new facilities. The Mission Aquatic Centre is an excellent example where all energy management opportunities were explored, business cases developed and the most cost effective and beneficial energy management upgrades were included in the design.

The following table is a cross section of energy saving initiatives that would be included in phase 2.2.1 of the Energy Management Plan.

Description	Costs of efficiency upgrade	Reduction of GHG in tonnes	Savings	Simple payback
Replace #1 Fire Hall boilers	\$30,000	42.7	\$9000	3.3
Replace Rutland Arena HWT's	\$35,000	22	\$4200	8
Replace Yards boilers	\$30,000	40	\$8200	4
Replace #3 Fire Hall furnaces	\$7000	11	\$2296	2.9

Estimated Retrofit Costs: \$102,000
 GHG Reduction: 115.7 tonnes
 Savings: \$23,696
 Average Simple Payback: 4 years

This equates to an overall average investment of \$882/tonne GHG emission

The following table is a cross section of energy saving initiatives that would be included in phase 2.2.2 (Electrical initiatives) of the Energy Management Plan.

Description	Costs of efficiency upgrade	Reduction of GHG in tonnes	Savings	Simple payback
Upgrade Rutland Arena lights	\$100,000	9.1	\$8900	11
PRC lighting fixture upgrades	\$70,000	10	\$8000	8.8
Theatre lighting upgrades	\$17,000	4	\$2900	6

Estimated Retrofit Costs: \$187,000
 GHG Reduction: 23.1 tonnes
 Savings: \$19,800
 Average Simple Payback: 9.4 years

This equates to an overall average investment of \$8095/tonne GHG emission

The following table is a cross section of energy saving initiatives that would be included in phase 2.2.2 (Natural Gas initiatives) of the Energy Management Plan.

Description	Costs of efficiency upgrade	Reduction of GHG in tonnes	Savings	Simple payback
Rutland Arena compressor heat recovery	\$425,000	159	\$35,000	12
Rutland Arena dressing room heat recovery	\$175,000	127	\$22,000	8
Rutland Arena DHW pre-heat	\$125,000	89	\$9000	15
PRC air to water heat pumps	\$200,000	106	\$17,500	11.5
Theatre outside air heat recovery	40,000	37	\$9500	5

Estimated Retrofit Costs: \$965,000
 GHG Reduction: 518 tonnes
 Savings: \$93,000
 Average Simple Payback: 10 years

This equates to an overall average investment of \$1862/tonne GHG emission

The following table is a cross section of energy saving initiatives that would be included in phase 2.2.2 (Solar initiatives) of the Energy Management Plan.

Description	Costs of efficiency upgrade	Reduction of GHG in tonnes	Savings	Simple payback
PRC Solar	\$350,000	168.5	\$28,000	13
Rutland Arena Solar	\$100,000	28	\$4000	25
#3 Fire Hall Solar	\$9,000	1	\$178	50

Estimated Retrofit Costs: \$459,000
 GHG Reduction: 197.5 tonnes
 Savings: \$32,178
 Average Simple Payback: 14.3 years

This equates to an overall average investment of \$2324/tonne GHG emission

3 Cost Summary of Energy Management Plan Initiatives:

Phase	\$/tonne	Average Simple Payback
2.1.1- Turn it off	\$519	1.6
2.2.1 - End of service life	\$882	4.0
2.2.2 - Gas	\$1862	10
2.2.2 - Solar	\$2324	14.3
2.2.2 - Electrical	\$8095	9.4

1. The average cost to reduce GHG emissions in phase 1 of the energy management plan is \$519/tonne with a simple payback of 1.6 years.
2. The average cost to reduce GHG emissions varies for all the available options in phase 2. Replacing equipment at the end of its service life is the most cost effective strategy followed by technical upgrades to reduce natural gas consumption, installation of solar systems and finally electrical reduction initiatives. All of these energy management strategies will be used to reduce GHG emissions in phase 2 and a calculated average of their costs is \$3290/tonne with a simple payback of 9.6 years.
3. A key component of phase 1 or 2 energy management initiatives will be tracking and monitoring to determine the true results. For any strategy to be successful we need to base our decisions on sound business cases and measurable reduction targets. We then need to monitor energy consumption to determine if we are meeting our reduction targets and make adjustments as needed. This information will contribute to the overall success of the plan and help us make better decisions regarding future energy management upgrades.

A sensitivity analysis was done to confirm these numbers and the testing criteria was a combination of the following:

1. Before the analysis was started an estimation of ranking was done to estimate the order of the most cost effective strategy to the least. The two lists were identical.
2. Cost per tonne was compared against known projects and the results were consistent with actual the energy management upgrade costs of phase 1 and 2. For example:
 - In 2003 the Rutland Arena refrigeration plant was re-commissioned by the Civic Properties HVAC Technician. Deferred maintenance issues were addressed and a new control strategy was implemented for the ice making plant. The impact of the commissioning was an improvement in plant efficiency which resulted in a 248,820 kWh reduction in electrical use and

an annual savings of \$12,441 in operational costs for the facility. This equates to a 9% overall reduction in energy consumption for the building, reduced GHG emissions of 13 tonnes and a simple payback of 4 months.

- The replacement of the heating and ventilation system at PRC at the end of its service life in 2004 cost \$192,000 and reduced GHG emissions by 295 tonnes. This works out to \$680/tonnes and a simple payback of 4.1 years.
 - The Mission Aquatic Centre has \$2,243,673 of energy management upgrades included in the design will result in a GHG reduction of 850 tonnes and a simple payback of 8.1 years. This strategy works out to a cost of \$2639/tonnes. This is lower than the average cost of phase 2 energy upgrades (\$3290/tonne) and as expected, shows it is more cost effective to design and install energy management upgrades in new buildings than to retrofit energy management upgrades into existing buildings.
3. The data from which costing was evaluated came from three different professional sources and all costing was consistent in each category.

4 Water Management Plan

The City has a goal to achieve a further 15% reduction in water consumption in City buildings and operations by 2012. This is a goal we can achieve through one energy management upgrade in Rutland Arena. Currently all the water for compressor cooling passes through each compressor once and then is sent to the snow melt pit and then to storm. This equates to an average of 35,350 cubic meters of wasted water annually and equates to 14% of the water usage for the city.

The energy management upgrade would include:

1. Re-circulation water system for compressor cooling.
2. Heat exchanger to recover discharge superheat from the compressor and transfer that heat to the snow melt pit.
3. Re-design of the snow melt pit to accommodate heat exchangers and allow for more water storage.

Estimated costs for this initiative are \$65,000 which would result in a savings of \$12,787 annually for a simple payback of 5 years. Considering this will effectively meet the goal of 15% reduction in City water usage I would recommend this be investigated further and a business case developed to provide justification for funding.

5 Breakdown of Costs to Achieve 20% Reduction of GHG Emissions

Through the initiatives in phase 2.1.1 we will be able to reduce energy consumption by an estimated 10% overall. This equates to:

Electrical kWh saved:	3,069,480 kWh
Natural Gas saved:	6,478 GJ
Electrical and Natural Gas savings:	\$221,444
Total overall Cost of Energy Upgrades:	\$260,019
Simple Payback:	1.2 years
GHG Reduction:	501 tonnes

Through the initiatives in phase 2.1.2 we will be able to reduce energy consumption by an estimated 4% overall. This equates to:

Electrical kWh saved:	1,227,792 kWh
Natural Gas saved:	2,591 GJ
Electrical and Natural Gas savings:	\$85,270
Total overall Cost of Energy Upgrades:	\$104,319
Simple Payback:	1.3 years
GHG Reduction:	201 tonnes

The outcome of phase 1 of the energy management plan will see a total reduction in GHG emissions of 702 tonnes at a cost of \$364,338. Our overall goal is to reduce GHG emissions by 1002 tonnes (20% of the City emissions) and phase 1 initiative will achieve 70% of our target. The remaining GHG reduction (300 tonnes) will have to come from Phase 2 initiatives.

Since the majority of GHG reductions come from energy management upgrades targeted at reducing natural gas consumption it is reasonable to estimate 80% of the remaining GHG reduction will come from phase 2 gas reduction initiatives and the remaining 20% from Phase 2 electrical reduction initiatives.

The breakdowns of phase 2 initiatives are:

Natural Gas saved:	4725 GJ
Electrical kWh saved:	1,071,429 kWh
Electrical and Natural Gas savings:	\$103,136
Total Cost of Energy Upgrades:	\$987,000
Simple Payback:	9.6 years
GHG Reduction:	300 tonnes