REPORTS OF COMMITTEES, COUNCIL REPRESENTATIVES AND STAFF

12. Corporate Climate Action Plan – File: 5280-14

Report: Corporate Energy Management Team, April 13, 2011

Moved by Councillor Keating, seconded by Councillor Clark

PURSUANT to the report of the Corporate Energy Management Team, dated April 13, 2011, entitled "Corporate Climate Action Plan":

THAT the Corporate Climate Action Plan be endorsed;

AND THAT the City adopt the overall corporate greenhouse gas reduction target of a 25% decrease below the 2007 baseline level by 2020;

AND THAT the City adopt interim corporate greenhouse gas reduction targets below the 2007 baseline level of 5% by 2013 and 15% by 2016;

AND THAT staff be directed to prepare detailed work plans and cost estimates to implement the recommended actions to achieve the City's corporate greenhouse gas emission reduction goals.

AND THAT a copy of the April 13, 2011 report be forwarded to the Province, the business community and the general community.

CARRIED UNANIMOUSLY

Director | City Manager

The Corporation of **THE CITY OF NORTH VANCOUVER**

REPORT

To: Mayor Darrell R. Mussatto and Members of Council

From: Corporate Energy Management Team

SUBJECT: CORPORATE CLIMATE ACTION PLAN

Date: April 13, 2011 File No: 5280-14

RECOMMENDATION:

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AND THAT staff be directed to prepare detailed work plans and cost estimates to implement the recommended actions to achieve the City's corporate greenhouse gas emission reduction goals.

ATTACHMENT:

1. Corporate Climate Action Plan, April 2011

PURPOSE:

The purpose of this report is to present to Council the draft Corporate Climate Action Plan and recommended greenhouse gas reduction target of a 25% reduction below 2007 levels by 2020.

BACKGROUND:

In 2005, Council adopted one of the first Local Action Plans in Canada for managing energy and emissions both corporately and in the community. A corporate goal of 20% below the 1995 baseline by 2010 (as per Partners for Climate Protection recommendations) was set for reduction of emissions through the City's corporate operations. Since the plan was adopted the City has managed to halt emissions increase despite the addition of facilities and fleet added since the 1995 baseline year.

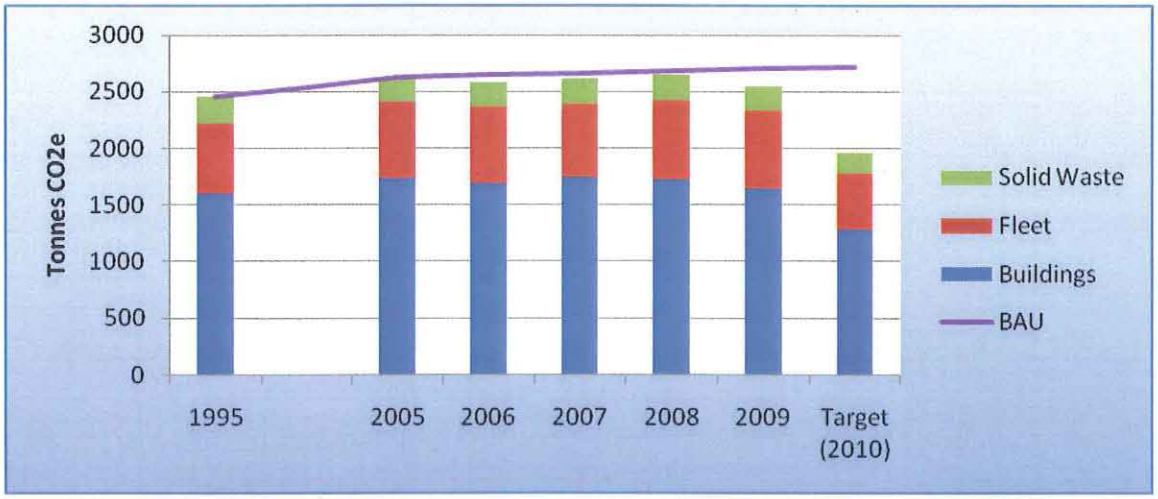


Figure 1. Corporate GHG Emissions and 2010 Local Action Plan target. ***BAU*** is business as usual emissions (0.7% growth annually).

Reduction of corporate emissions presents opportunities to show leadership, to build capacity and to drive innovation in the marketplace. If the City is to make progress in influencing the reduction of community-wide emissions it is critical to lead by example in the reduction of corporate emissions.

Plan Development

In July 2010, Council directed staff to update the Corporate Climate Action Plan. During the past eight months the City's Corporate Energy Management Team has led the development of the plan, providing operations level advice and review as a technical steering committee, with high-level guidance on plan development from the Directors Team. The plan has been written by Enerficiency Consulting and the City's Research Assistant, Climate Action.

DISCUSSION:

Background research completed for the plan update includes an assessment of opportunities to improve energy efficiency in the City's existing buildings stock, an examination of City infrastructure such as street lights, a review of the City's fleet undertaken by the Fraser Basin Council's E3 Fleet program, a waste assessment at all facilities, a detailed waste audit at City Hall, and a comprehensive staff engagement process. The results of this work have been presented to Council as information reports during the past two months and also appear as appendices to the draft Corporate Plan.

A workshop was held with Council on February 28, 2011. The results of opportunity assessments in the facilities, fleet, and solid waste areas were presented and direction was sought to inform target development, from low (3%) to high (34%). An overview of costs was also presented: major cost items included a comprehensive building retrofit, LEC connections for existing buildings, a streetlight retrofit, and fleet upgrades. A high level of staff engagement was assumed for all but the lowest target scenario.

Council direction was to proceed with plan development, with a medium to high reduction target. Staff have followed Council's direction in drafting the attached plan and associated 25% target, working with Enerficiency Consulting. An overview of actions in the plan towards meeting this ambitious yet achievable target is presented below.

Cost associated with this ambitious target is 2 to 3 million dollars over five years or approximately $500,000 per year. It is worth noting that the 25% target exceeds the community target of a 15% reduction by 2020, so the City is leading by example in setting a more aggressive target for its own operations.

Buildings, LEC, Infrastructure, and Information Technology

Buildings and infrastructure comprise 86% of the City's energy use and 64% of the City's corporate greenhouse gas emissions. Recommended actions include:

- Determine future building plans and undertake a comprehensive project to retrofit all buildings;
- Connect buildings to LEC;
- Make energy and emissions a priority for the Harry Jerome upgrade; and
- Encourage LEC to publish an annual emissions factor and set a target for lowering their emissions factor over time.

Buildings and Future Facility Planning

Although the future of some buildings is uncertain, it is important that these buildings not be overlooked. While it does not make sense to undertake extensive renovations in a building that may be demolished, there are many low cost/ short payback measures that can be undertaken, particularly if it is known that the building will be in place for the next few years. Failure to take any action in buildings with uncertain futures will make targeted emission reductions very difficult, if not impossible, to achieve.

Fleet

The City's fleet comprises 14% of energy use and 27% of greenhouse gas emissions. Staff have formed a Green Fleet Team to continue to identify further opportunities to optimize the fleet towards reducing emissions and costs. Recommended actions include:

- Conduct driver training to reduce fuel consumption;
- Implement changes to operations and landscape design to minimize energy use;
- Ensure that replacement vehicles are both fuel efficient and most appropriate for use.

Vehicle Replacement

Of note, lower emission alternatives for some vehicles, particularly for larger vehicles with a disproportionate impact on the City's fleet emissions, are currently not available, while other vehicles such as the City's pool vehicles, which are smaller energy consumers, will continue to be upgraded more readily. Implementation of a robust replacement vehicle policy will ensure the most appropriate vehicle is chosen for the task the vehicle is being used for, and that viable technologies are adopted as they become available.

Solid Waste

Solid waste comprises 8% of the City's greenhouse gas emissions. Recommended actions include:

- Conduct waste audits at City facilities to identify reduction opportunities;
- Provide food waste collection for food scraps at all facilities; and
- Continue to expand the provision of on-street recycling infrastructure.

Policies and Staff Awareness

Policy changes and staff awareness are key to achieving success. The recommended 25% reduction target can only be achieved with the participation of all staff. Recommended actions include:

- Adopt a zero waste meeting policy;
- Develop criteria for vehicle purchases;
- Add criteria for small buildings and renovations to the LEED Standards for Civic Buildings policy;
- Develop and provide funding and resources to implement an ongoing staff behavior and awareness program.

Targets, Monitoring, and Reporting

Along with the 25% reduction target to be achieved by 2020, two interim targets are proposed: a 5% reduction by 2013 and a 15% reduction by 2016.

Indicators have also been developed, and include the following:

- Energy use in City facilities (GJ);
- Percent of civic floor space connected to LEC;
- Percent of energy use from renewable sources both on-site and through LEC;
- Fleet efficiency (L/100 km);
- Percent reduction in fleet kilometers travelled; and
- Tonnes of solid waste disposed of each year.

The plan recommends annual reporting on energy consumption, GHG emissions, and indicators.

Carbon Neutrality: 2012 Requirements Under the Climate Action Charter

Staff received direction from Council in July 2010 to update the corporate component of the Local Action Plan. At that time the plan was intended to address staff engagement strategies, opportunities for energy and waste reduction, and the City's 2012 carbon neutrality commitment under the B.C. Climate Action Charter.

It was hoped that during this time it would be possible to achieve additional clarity with respect to what would be considered an acceptable offset under the Climate Action Charter. While there have been a number of developments since July 2010 (of note, the Province released a draft Framework for local government carbon neutrality at the UBCM meeting in September 2010), it is still somewhat unclear how any local offset mechanism would work and a staff workshop is scheduled for April to further discuss the draft Framework with representatives of the Province's carbon neutral working group. The area is very complex and evolving rapidly, and staff recommend that the subject be dealt with in a subsequent analysis and report later in 2011 once more guidance and information is available from the Province.

INTERDEPARTMENTAL IMPLICATIONS:

This report was reviewed by the Directors Team on March 29, 2011. Successful implementation of the Corporate Climate Action plan and attainment of the 25% reduction target is dependent on the contributions of all staff, but in particular, staff in the following areas: Recreation Commission, LEC, Facilities, Public Works, Traffic and Transportation, Parks, and Purchasing. The engagement of all staff in implementing reduction initiatives is required to achieve the 25% reduction target. Staffing implications include reprioritization of roles and responsibilities associated with changes in the manner in which the City provides services to the public. Department responsibility is detailed on page iv of the executive summary of the attached draft. Members of the Corporate Energy Management Team would be tasked with coordinating the implementation and reporting associated with the Corporate Climate Action Plan.

FINANCIAL IMPLICATIONS:

To achieve the targeted reductions, a financial investment will be required. Major cost items include a comprehensive building retrofit, LEC connections for existing buildings, a streetlight retrofit, and fleet upgrades. Project management and education/outreach costs are included in this budget. A high level of staff engagement is assumed.

Cost estimates are as follows: 2 to 3.1 million dollars over the next five years, or $400,000 to $620,000 annually. Costs provided are preliminary, high-level estimates: costs of specific items would be further refined prior to proceeding with specific project implementation.

Once the majority of items in the plan are implemented, in particular the comprehensive building retrofit, the City can expect to see annual energy cost reductions of $300,000 to $350,000 (current energy prices) by achieving the 25% reduction target, providing a simple payback of 6 to 10 years.

Budgeted costs are based on key measures for energy and GHG reduction. Other building upgrades resulting in energy efficiency (for example, renewal of the City Hall building envelope, cost of 1.6 million) are not included in this estimate. Such upgrades have value in their own right as they improve building operation and staff working conditions, and thus increase efficiency and productivity in the longer term. Actions that are expected to occur anyway, without a premium cost for energy efficiency, have not been included. As well, no costs have been included for energy efficiency in new or substantially upgraded buildings such as the potential Harry Jerome redevelopment.

Costs will primarily impact capital budgets: however, a notable exception is the City's fleet. Funding implementation of upgrades to the Public Works fleet is unique in that each fleet vehicle has a chargeout rate which is costed to a specific program or project each time the vehicle is used. After deducting vehicle fuel and maintenance costs, the balance of the charge-out rate funds the Engineering Equipment Reserve. This Reserve then funds replacement of the fleet vehicles. Therefore, should fleet utilization remain constant, cost increases to fleet chargeout rates may be needed to fund more energy efficient vehicles, and these increased chargeout rates would in turn impact operation, utility, and capital budgets accordingly.

Of note, the City's buildings portfolio, is valued at approximately $150 million dollars. Thus, $620,000 represents a small annual investment. The longer such upgrades are postponed, the greater the cost of such upgrades, and the greater cost of missed energy savings and operational efficiencies. The City is obligated to be carbon neutral in 2012 under the Climate Action Charter: therefore, implementation of energy savings will reduce the City's carbon liability, and to a greater degree depending on how early measures are taken.

In addition to annual savings estimated of approximately $300,000 once all programs are fully implemented, there are other important benefits of this Corporate Climate

Action plan which are more difficult to quantify (e.g. improved staff comfort, engaged work force) but which could have a significant impact on the City's bottom line due to reduced human resources-related costs.

Funding of the corporate climate action plan, if adopted by Council, would be considered through prioritization of existing budgets.

SUSTAINABILITY IMPLICATIONS

The City's endorsement of the Corporate Climate Action Plan is consistent with sustainability principles as outlined in the City's Official Community Plan, in particular targets, policies and actions for reducing energy use and emissions.

RESPECTFULLY SUBMITTED BY:

Caroline Jackson, M.Sc.
Community Energy Manager

DRAFT

Corporate Climate Action Plan

City of North Vancouver

Prepared For: City of North Vancouver

Prepared by: Michael Wilson, P.Eng.
Enerficiency Consulting
and
Julie Cecchetto, B.Sc.
City of North Vancouver

April 14, 2011

Table of Contents

Acknowledgements

We would like to express our thanks to all the City of North Vancouver staff who contributed their knowledge and expertise to the development of this plan. Particular thanks go to the members of the City's Energy Management Team:

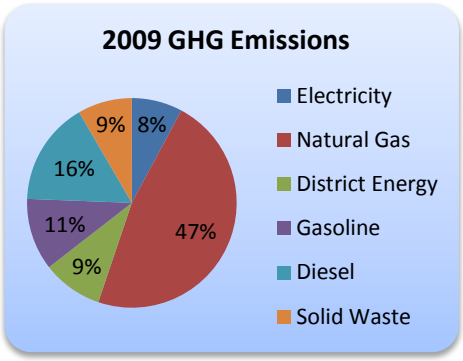
Leslie Garber, Manager, Accounting Services
Nikii Hoglund, Manager, Public Works
Gary Houg, Manager, Maintenance and Engineering Services,
North Vancouver Recreation Commission
Richard Howard, Maintenance Coordinator
Janice Irwin, Manager, Financial Services
Caroline Jackson, Community Energy Manager
Glenn Stainton, Manager, Facilities, and Vice President Operations,
Lonsdale Energy Corporation
Dave Turner, Manager, Parks
Dave Williams, Traffic Technologist
Brian Willock, Manager, Streets and Fleet

Executive Summary

The City of North Vancouver is a signatory to the Climate Action Charter and has committed to being carbon neutral in its own operations by 2012. This entails reducing energy consumption and greenhouse gas (GHG) emissions as much as possible and purchasing offsets for any remaining emissions. The City undertook a combined corporate and community action plan in 2005. This plan update identifies opportunities for energy and emissions reductions and recommends reduction targets, policies, and actions for becoming carbon neutral.

2009 Inventory by Emissions Source

	GJ	$	CO_2e (tonnes)	%
Electricity	32,661	$ 635,100	200	7.8%
Natural Gas	23,667	$ 241,400	1,207	47.4%
District Energy	3,815	$ 48,000	237	9.3%
Gasoline	4,077	$ 107,200	283	11.1%
Diesel	6,017	$ 139,800	408	16.0%
Solid Waste		$ 68,900	214	8.4%
Total	70,236	$ 1,240,400	2,549	100%



2009 Inventory by Sector

	GJ	CO_2e (tonnes)	%
Buildings - CNV	35,690	864	33.9%
Buildings - NVRec	24,453	780	30.6%
Fleet	10,094	691	27.1%
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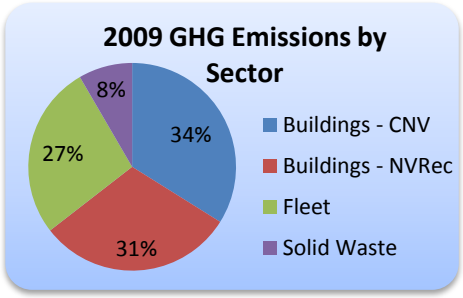

Reduction Opportunities

Although many actions have been taken by the City, there are still considerable opportunities remaining. As part of this plan, an opportunity assessment of buildings was performed, as well as an E3 Fleet assessment and a waste audit of City Hall. Policies and staff engagement opportunities were also investigated. Staff and council were involved extensively in the development of the plan through a staff questionnaire, interviews with key staff, a workshop for senior staff and council, and the involvement of the Energy Management Team. Key areas of reduction potential are:

- Building energy efficiency retrofits.
- Connection of buildings to LEC.
- Fleet replacement policy.
- Driver training, trip planning, and crew deployment.
- Expanded recycling, including organics.
- Staff engagement.

Recommended Reduction Target & Budget

A new target for GHG reductions has been developed, based on striking a balance between showing leadership and the ability to achieve the targeted reductions. The recommended target is a 25% GHG reduction by 2020, from 2007 levels.

A suggested budget range in order to achieve the recommended target is $2.0 to $3.1 million over 5 years.

Recommended Actions

Action		Timeframe	Responsibility
1.1	Monitor and report annually on energy consumption, GHG emissions, and indicators.	Ongoing	Community Energy Manager, All
Buildings & Infrastructure			
2.1	Determine future building plans and undertake a comprehensive project to retrofit all buildings.	2012 - 2014	Facilities, NVRec
2.2	Connect buildings to LEC.	2011 - 2018	Facilities, LEC, NVRec, Planning
2.3	Make energy efficiency and GHG emissions a priority for the Harry Jerome upgrade or redevelopment. Target total GHG emissions of at least 25% lower than emissions of the existing facilities.	TBD	Planning, NVRec
2.4	Work together with LEC to identify and support renewable alternatives in LEC's system, particularly in the Harry Jerome redevelopment.	Ongoing	Facilities, NVRec, LEC
2.5	Encourage LEC to publish an annual emissions factor and set a target for lowering their emissions factor over time.	2011	LEC
2.6	Conduct an audit of streetlight types and light levels.	2012	Traffic and Transportation
2.7	Conduct a further investigation of streetlight dimming technology. If viable and there are no reliability concerns, proceed with a comprehensive retrofit.	2012 - 2016	Traffic and Transportation
2.8	Continue to monitor developments and cost of new streetlighting technologies, piloting new streetlight technologies where opportunities arise.	Ongoing	Traffic and Transportation
2.9	Continue with plans to upgrade server hardware and virtualization.	Ongoing	IT
2.10	Run an outreach program for staff to shut off computers at night.	2011	IT, Green Team
2.11	Investigate opportunities to recover waste heat from the Fire Hall servers.	2011 - 2012	IT, Facilities
2.12	Initiate a cloud computing pilot.	2011 - 2013	IT
Fleet			
3.1	Utilize the E3 Review to identify underperforming vehicles and take corrective action to assist in identifying vehicles for replacement.	2011	Public Works, Fire
3.2	Initiate a fuel efficiency driver training program.	2012	Public Works, Parks
3.3	Review task scheduling procedures and driving routes to determine if vehicle use can be reduced.	2012	Public Works, Parks
3.4	Ensure that replacement vehicles are both fuel-efficient and the most appropriate vehicle for the use.	Ongoing	Public Works, Fire

Solid Waste			
4.1	Conduct visual assessments of waste volumes at all facilities on an annual basis, and adjust pickup frequency as needed.	Ongoing	Community Energy Manager, Facilities
4.2	Conduct regular waste audits of core facilities to accurately track quantities and sources of waste generated and assess effectiveness of diversion programs.	Ongoing	Facilities, Community Energy Manager
4.3	Provide food waste collection for food scraps, other organics and compostable paper at all facilities.	2013	Facilities, Public Works
4.4	Expand recycling programs at all facilities to include blue bin materials, mixed paper and deposit beverage containers and expand the provision of on-street recycling infrastructure.	2012	Facilities
Renewable Energy			
5.1	Consider best available renewable energy source for future facilities or upgrades (e.g. solar thermal for pool water heating and geo-exchange for space heating/cooling in the Harry Jerome redevelopment).	Ongoing	Facilities, LEC, Planning
5.2	Work with LEC to evaluate the use of biomass heating.	2012	Facilities, LEC
5.3	Implement pilot projects, where operationally feasible, to showcase technologies to the public.	Ongoing	All
Policies			
6.1	Add criteria for small buildings and renovations to the *LEED Standards for City of North Vancouver Buildings* policy.	2011	Facilities
6.2	Develop criteria for vehicle purchases and provide documentation.	2011	Purchasing, Public Works
6.3	Develop selection criteria for equipment purchases based on EnergyStar.	2011	Purchasing
6.4	Adopt a zero waste meeting policy.	2011	Community Energy Manager, All
Staff Awareness			
7.1	Develop and provide funding and resources to implement an ongoing staff behaviour and awareness program.	2011 - 2013	Community Energy Manager, Facilities

1. Introduction

1.1 Background

The City of North Vancouver is a leader in BC in taking action on climate change, and is a signatory to the Climate Action Charter, committed to being carbon neutral in its own operations by 2012. This entails reducing energy consumption and greenhouse gas (GHG) emissions as much as possible and purchasing offsets for any remaining emissions.

The City has long been interested in reducing energy consumption within its operations. Some of the achievements include:

- Joining the Federation of Canadian Municipalities Partners for Climate Protection (PCP) program in 1997.
- Compiling a corporate inventory in 2001, with ongoing updates.
- Undertaking a corporate greenhouse gas action plan in 2005.
- Hiring a corporate energy coordinator in 2008
- Construction of a LEED Gold library in 2008.
- Various retrofits in corporate buildings.
- Establishment of a corporate purchasing policy.
- Becoming one of the first municipalities in Canada to complete all five milestones of the PCP program.

This corporate action plan will build on the efforts to date in order to establish a plan for meeting the City's commitments. It will identify opportunities for energy and emissions reductions, and recommend updated reduction targets, policies, and actions.

1.2 2005 Action Plan

The 2005 action plan was developed as part of a larger community-wide action plan. It incorporated a baseline of emissions, business-as-usual (BAU) forecast, objectives, targets, and recommended actions. The target for corporate reductions was 20% from the 1995 baseline by 2010 (28% reduction vs BAU). This target aimed to reduce corporate emissions by 491 tonnes CO_2e to 1,963 tonnes by 2010. Initiatives identified in the plan were:

Table 1: 2005 Corporate Plan Initiatives

Initiative	Completed?
Corporate building retrofits	Partial
New building standards	Yes
Connect CNV buildings to LEC	Partial
Purchase green power	Yes, but no longer available from BC Hydro
Use of 20% bio-diesel	Partial
Replacement and right-sizing of vehicles	Partial
Driver training/vehicle maintenance	Partial
Procurement policy	Yes

While it can be seen that some progress has been made on most initiatives, there is still considerable work to be done.

2. Inventory & Forecast

2.1 Inventory

The City first undertook a corporate inventory in 2001, using 1999 data and a 1995 baseline (as was recommended by PCP at the time). An update was done in 2006 using 2005 data. Since then the Province has released guidelines for developing local government inventories for the purposes of reporting under the Climate Action Charter, which have different scope and emissions factors than were used for the 2001 inventory. The Province has also developed an online reporting system called SmartTool, for tracking and calculating emissions. The City has since updated the inventory for the years 2005 to 2009 using a consistent methodology and data, based on the provincial guidelines but including solid waste and emergency services as required under PCP.

Under the provincial guidelines, vehicle emissions from contracted services such as garbage and recycling are to be included. Recognizing the difficulty in obtaining information from contractors, the Province has stated that these emissions do not need to be included until the contract is renewed after 2012. Once these emissions are known, the City may choose to include them within the inventory or may simply choose to report them separately. If they are included, reduction targets may need to be adjusted.

The new provincial guidelines do not include methane emissions from solid waste generated in corporate facilities. This is a required component of the PCP program and has been included in the City's inventory. Most solid waste quantities are estimated based on bin size and pickup frequency, although the works yard tracks actual solid waste quantities including litter from street and park garbage bins.

The inventory is summarized below. It can be seen that while electricity is the largest source of energy consumption and energy cost, it accounts for only 8% of GHG emissions. This is due to the low emissions factor from BC Hydro, which has primarily hydro generation. Natural gas is the largest source of emissions, at 47%. Total emissions are 2,567 tonnes CO_2e. At the current price of $25/tonne for carbon offsets, this would require an offset payment of $64,175 annually. Offsets are discussed further in Section 4.

Table 2: 2009 Inventory Breakdown by Emissions Source

	Consumption	GJ	$	CO_2e (tonnes)	%
Electricity	9,072,615 kWh	32,661	$ 635,100	200	7.8%
Natural gas	23,667 GJ	23,667	$ 241,400	1,207	47.4%
District Energy	3,815 GJ	3,815	$ 48,000	237	9.3%
Gasoline	116,473 L	4,077	$ 107,200	283	11.1%
Diesel	157,104 L	6,017	$ 139,800	408	16.0%
Solid Waste	441 tonnes		$ 68,900	214	8.4%
Total		**70,236**	**$ 1,240,400**	**2,549**	**100%**

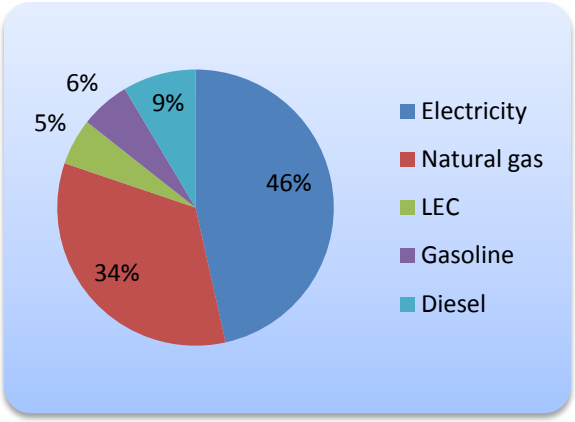

Figure 1: 2009 Energy Consumption (GJ)

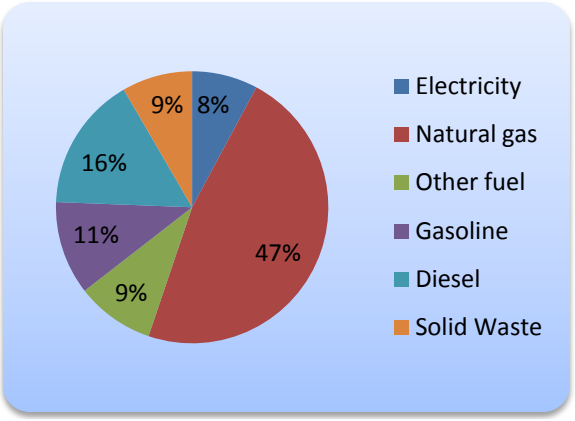

Figure 2: 2009 GHG Emissions (tonnes CO_2e)

When consumption and emissions are broken down by sector it can be seen that buildings account for the majority of energy consumption, followed by fleet. However, fleet accounts for a larger share of GHGs, as much of the buildings consumption is electricity. GHG emissions are split almost equally between City buildings and those operated by the North Vancouver Recreation Commission (NVRec).

Table 3: 2009 Inventory Breakdown by Sector

	GJ	CO_2e (tonnes)	%
Buildings - CNV	35,690	864	33.9%
Buildings - NVRec	24,453	780	30.6%
Fleet	10,094	691	27.1%
Solid Waste		214	8.4%
Total	**70,236**	**2,549**	**100%**

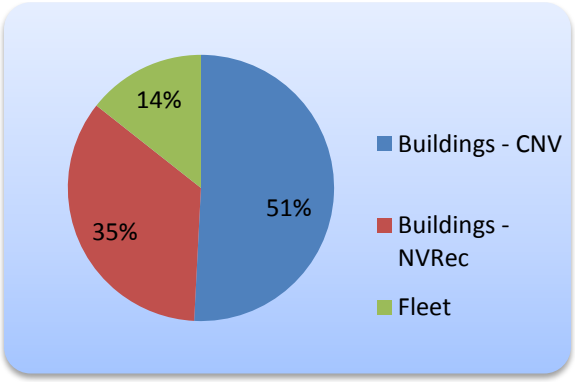

Figure 3: 2009 Energy Consumption (GJ)

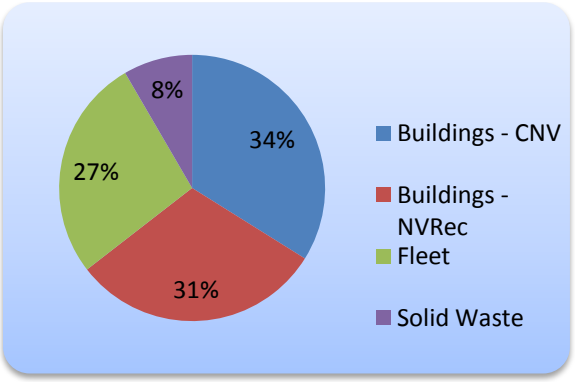

Figure 4: 2009 GHG Emissions (tonnes CO_2e)

Emissions have been relatively stable over the past few years, in spite of adding some new buildings and vehicles. Emissions have, in fact, not changed significantly since the 1995 baseline, and current emissions are 5.8% below the BAU forecast. However, they remain 30% above the 1,963 tonne target adopted by Council.

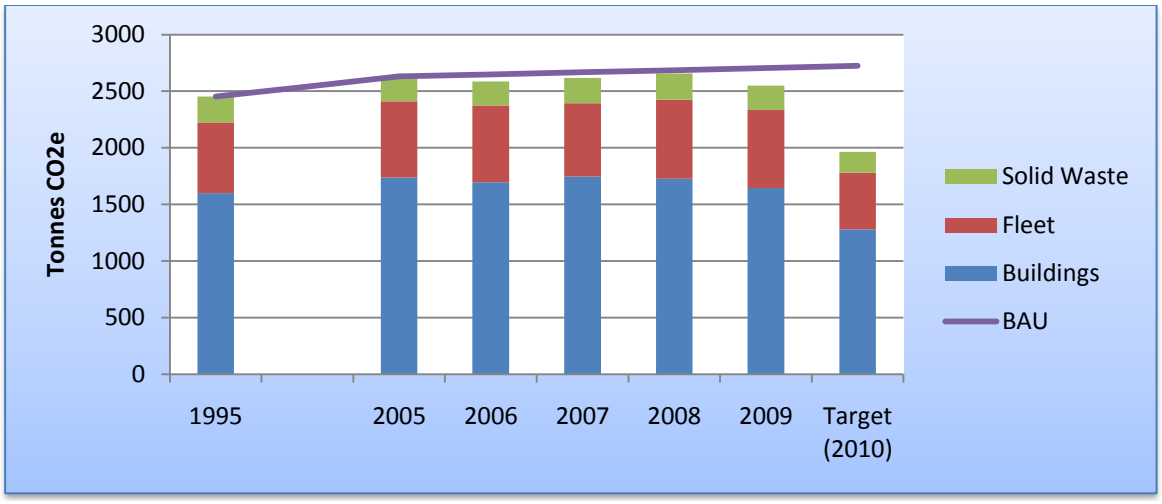

Figure 5: GHG Emissions & Forecast, 1995 - 2009

2.2 Business As Usual Forecast

Forecasting corporate emissions is a difficult task. This is because the addition of new facilities can dramatically change the inventory profile, yet details of the projects are often not well developed. In North Vancouver there are potential plans for a new recreation centre or an upgrade to the existing facility at the Harry Jerome site, which may have a significant impact, positive or negative, on emissions. Rather than trying to predict the impact of individual projects, a consistent annual growth rate is used, recognizing that the rate will actually change from year to year.

The 2005 plan included a BAU forecast to 2010 equivalent to 0.7% annual growth. The rationale for this figure is not known, but at half the rate of population growth it is a reasonable value and will be used to continue the forecast in this plan.

At 0.7% annual growth, emissions can be expected to reach 2,920 tonnes CO_2e by 2020, an increase of 15% over current emissions.

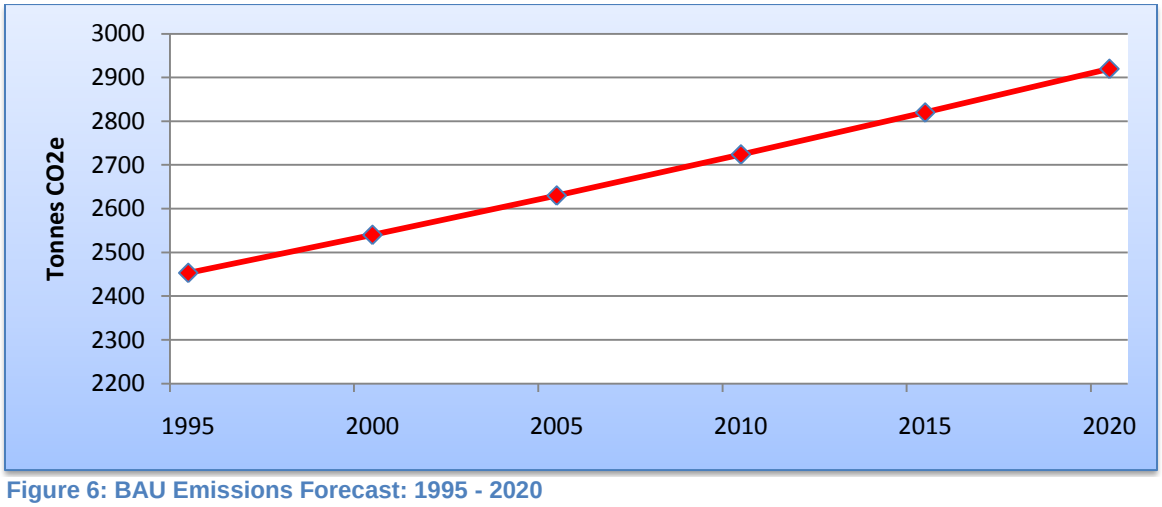

Figure 6: BAU Emissions Forecast: 1995 - 2020

2.3 Improvements to the Inventory

Although the accuracy of the inventory improves with each iteration, there are several changes that could be made to improve accuracy and the ease of data collection:

- A number of buildings are leased to non-profit organizations who pay their own energy bills. This makes it difficult to gather the information and in some cases the bills have been missed from some inventory years. If the City were to take over the payment of these bills it would greatly simplify data collection. It would also remove a barrier to implementing efficiency retrofits, which is that the City would not see the benefit (the non-profit groups are unlikely to implement retrofits as they have limited funds and do not own the building). Energy costs could be billed back to tenants, or absorbed by the City (the City provides significant financial support to these organizations anyway).
- The emissions factor for LEC has been estimated based on plant efficiencies provided by LEC. It would be an improvement if LEC were to publish an annual GHG emissions factor, similar to BC Hydro. This should include all sources of energy, which will become increasingly important as more alternative energy sources are introduced into LEC's production mix. Over time, such an emissions factor would provide a mechanism to report annual improvements in both LEC's efficiency and carbon footprint over time.
- Only the Works Yard actually measures solid waste collected, through tipping fees paid at the transfer station. For other facilities, solid waste emissions are estimated based on bin size and pickup frequency, with an assumption that bins are 80% full. These assumptions were made in 2006 and the same values have been used each year through to 2009. This methodology should be amended to include a visual assessment of the estimated volume of waste at all core City facilities at the time of collection to allow for a more accurate assessment of waste volumes. These assessments should occur each year in order to track progress in solid waste reductions.

3. Opportunities

3.1 Buildings & Infrastructure

3.1.1 Buildings

Buildings account for nearly two-thirds of overall emissions. While many energy efficiency retrofits have occurred, there are still opportunities for savings. Most retrofits have been one-off projects, rather than a comprehensive retrofit of all buildings and systems.

An opportunity assessment was performed on 13 of the largest buildings, which account for nearly 90% of building energy consumption. The opportunity assessment included an assessment of energy consumption and a site visit to each facility. It identifies cost effective opportunities for each building, along with broad estimates of savings and overall costs. The opportunity assessment is included in Appendix A.

The main energy conservation opportunity in the buildings is to improve heating plant efficiency by replacing old boilers, installing isolation valves or flue dampers, or by connecting the buildings to LEC. This opportunity is complicated somewhat by the uncertain status of many of the buildings, some of which are being considered for demolition and possible replacement or

relocation. Because of this, only the lowest cost boiler improvements were included in the recommended measures. Confirming the future of these buildings and developing an overall boiler upgrade/LEC connection plan will be important to further reducing emissions. Even if the future use of a building cannot be confirmed, it may still be possible to connect to LEC and re-use the piping and heat exchangers when or if the building is renovated or demolished. LEC is currently in the process of connecting to the Fire Hall and expects this work to be completed by April 2011. Presentation House has a design for connection in place and is awaiting a connection date. Connection of the RCMP building is planned for 2011, with the existing boilers providing peaking and emergency back-up capabilities to the LEC system.

Another significant opportunity is lighting retrofits, replacing older lamps and ballasts with new technologies. Many of the lights have already been changed, but others remain. In addition to saving energy, this will provide better lighting quality and an improved work environment. Other opportunities include improved building controls, variable speed drives and CO_2 control, occupancy sensors, adding insulation, and sealing and weatherstripping the building envelope. The measures are summarized below:

Table 4: Recommended Measures – Opportunity Assessment of Buildings

Building	Recommended	Optional
RCMP	Reduce light levels CO_2 ventilation control Confirm ventilation requirements	Connect to LEC
Fire Hall	Lighting retrofit / redesign Insulated bay doors Interlock bay doors with heating	
City Hall & Library	Lighting retrofit / redesign Occupancy sensors Connect DHW to LEC	
New Library	Review dimming/occupancy controls Use ground loop for heating Use ventilation fans for free cooling	
City Works Yard	Lighting retrofit / redesign Weatherstripping/sealing Insulated bay doors Interlock bay doors with heating Daylighting Disconnect radiant outdoor heaters	Solar wash water heating
Presentation House	Lighting retrofit Weatherstripping/sealing Insulate attic space Thermostatic radiator valve Insulate bare piping Programmable thermostats Boiler flue damper	New hi-efficiency boiler, *or* Connect to LEC Window replacement
NS Neighbourhood House	Lighting retrofit / redesign CO_2 ventilation control Boiler flue dampers	New hi-efficiency boilers, *or* Connect to LEC
Mahon Park Facilities	Lighting retrofit Weatherstripping/sealing High efficiency furnaces Programmable thermostats Lockbox or relocate stadium thermostat	Insulate walls

John Braithwaite	Lighting redesign Recommission controls CO_2 ventilation control	
Mickey McDougall	Lighting retrofit CO_2 ventilation control Variable speed drives New stand-alone DHW tank	
Harry Jerome	Lighting retrofit Heat recovery from ice plant Ice temperature controls Boiler isolation/flue dampers	New hi-efficiency boilers, *or* Connect to LEC
Centennial Theatre	Lighting retrofit CO_2 ventilation control Variable speed drives Boiler flue damper	Connect to LEC
Memorial Gym	Lighting retrofit CO_2 ventilation control Variable speed drives Boiler flue damper	Connect to LEC

The overall savings from these measures is estimated at 12% of buildings energy cost, or $80,600 annually. Annual GHG savings would be 222 tonnes, or 15%. The estimated one-time installation cost for the base project is approximately $650,000, including engineering and project management. It should be noted that these are rough estimates, and an appropriate contingency should be included.

The potential savings is somewhat lower than might be expected for a number of reasons. The City's buildings have lower energy use than typical buildings elsewhere. And, as mentioned above, only the lowest cost boiler improvements have been included. With full boiler replacements or connection to LEC, energy savings would rise to approximately 15% and GHG savings to 24%.

The most cost effective way to implement these measures would be as a comprehensive retrofit project that undertakes all the buildings at one time, particularly for lighting. This will provide economies of scale and reduce contractor time, as well as maximizing savings. A comprehensive retrofit will require additional staff time to manage the project. Currently, staff capacity is an issue with regards to undertaking energy efficiency work and this will need to be addressed.

Although the future of some buildings is uncertain, it is important that these buildings not be ignored. While it does not make sense to undertake extensive renovations in a building that may be demolished, there are many low cost/ short payback measures that can be undertaken. As mentioned above, LEC connection piping and heat exchangers can be re-used in a redeveloped building. Failure to take any action in buildings with uncertain futures will make achievement of targeted reductions very difficult to achieve. See Section 3.1.2 for further discussion on this issue as it relates to Harry Jerome.

Many of the simpler measures should also be applicable to the smaller buildings not covered by the opportunity assessment. These include lighting retrofits, programmable thermostats, and boiler flue dampers. A similar level of savings is likely achievable in those buildings.

Recommendations:

- Determine future building plans and undertake a comprehensive project to retrofit all buildings.
- Connect buildings to LEC.

3.1.2 Harry Jerome Redevelopment

Harry Jerome is the largest GHG emitter in the City's portfolio. Currently, consideration is being given to a new or upgraded recreation centre that combines the recreation services provided by Harry Jerome, Memorial Gym, and Mickey McDougall. Construction of a new recreation centre provides a significant opportunity to reduce emissions, particularly with the City's policy of LEED Gold certification for new buildings. However, it should be noted that new recreation centres do not necessarily use less energy than older ones and in many cases may consume more. The existing City recreation facilities have quite low energy consumption and a new or upgraded recreation centre will need to aggressively target energy consumption in order to not cause an increase in overall emissions. See Appendix B for a brief on potential energy and emissions impacts of the Harry Jerome redevelopment.

Recommendations:

- Make energy efficiency and GHG emissions a priority for the Harry Jerome redevelopment.
- Target total GHG emissions for a new or renovated Harry Jerome of at least 25% lower than emissions of the existing facilities.

3.1.3 Lonsdale Energy Corporation

LEC operates as a utility with multiple customers, including the City although rate changes and future plans are approved by Council. Where City buildings are connected to LEC, the City must apply an emissions factor based on the fuel mix and generation efficiency of LEC's operations. This is similar to the way an emissions factor is applied to electricity purchased from BC Hydro. At the moment the emissions factor is based mostly on combustion of natural gas with a small amount from solar panels atop the roof of the City's library which provide heat, most of which occurs during the summer months. As LEC adds more customers, along with renewable or low carbon energy sources to their production mix, the emissions factor will drop as efficiencies and the renewable mix increase.

Because of this emissions factor, efforts made by LEC to reduce emissions directly impact the City's corporate and community emissions. Conversely, it will be more difficult for the City to make significant long-term reductions in GHG emissions if LEC's emissions factor does not change. As more City buildings connect to LEC, the emissions factor will become a more important component of the City's emissions.

The City has worked with LEC in the past to incorporate renewable energy into their system (solar panels on the new library). There may be substantial opportunities in the Harry Jerome redevelopment or other projects for similar joint efforts to reduce emissions.

Recommendations:

- Work together with LEC to identify and support renewable alternatives in LEC's system, particularly in the Harry Jerome redevelopment.
- Encourage LEC to publish an annual emissions factor and set a target for lowering their emissions factor over time.

3.1.4 Streetlights

Streetlights account for 12% of the City's electricity consumption. Roughly 70% of the streetlighting is owned by the City, with BC Hydro owning and maintaining the remainder. Most of the fixtures are high pressure sodium (HPS), with some metal halide. Both are reasonably efficient light sources. While the efficiency of HPS is slightly higher than metal halide, the light quality and colour of metal halide is better. Both BC Hydro and the City now use low cut-off fixtures for new streetlights to reduce glare and improve efficiency, which may reduce energy consumption in new installations.

The City has an inventory of streetlight quantities and wattage. A further audit should be conducted to include the type of streetlight and light levels. This inventory could be cross-referenced with the City's various Parks and Trails Master Plans as well as its Transportation Master Plan to ensure that appropriate light levels are being provided. It could also be used to help identify locations where further pilot studies of new technologies may be implemented to realize the greatest savings.

Streetlights are characterized by a need to withstand the harsh outdoor environment and relatively poor power quality. They are also difficult to change, so lamp life is a critical factor. Streetlight efficiency improvements are currently focused in four major areas, none of which are yet proven technologies:

Pulse start/electronic ballast metal halides. These higher efficiency lamps and ballasts result in up to 30% lower energy consumption, as well as longer lamp life. Although pulse start metal halide is relatively common for indoor applications, there are still concerns regarding their durability in streetlights.

LED lamps. LED lamps are considered by many to be the way of the future for streetlighting. Not only is there significant energy savings potential, but lamp life is much longer. At this time the costs of LED streetlights are very high and they are not cost effective. There are also some questions about reliability. But costs are dropping rapidly and this will likely be the dominant technology in a few years. The City has tested an LED streetlight in front of the municipal hall for the past year, with no complaints.

Solar power. Solar powered streetlights, in combination with LED lamps, could eliminate streetlight energy consumption. But solar power is still very expensive. Even with solar prices dropping, it is not likely that solar power will be competitive with BC Hydro in the foreseeable future. Several municipalities have tried solar powered streetlights as demonstration projects. There are some concerns around

battery life and light output after extended periods of darkness. Where solar powered lights are likely to be cost effective (both now and in the future) is in applications where the cost of providing power to the pole can be eliminated.

Dimming systems. There are systems available which allow for streetlights to be dimmed during non-peak hours. Energy savings of up to 40% are claimed, although installation costs are high. These are most applicable to areas where light levels are not as critical, such as pathways or parking lots, rather than intersections or busy roads.

At this time there is no obvious technological change to be pursued. The City should continue to research and test technologies until prices come down and reliability improves.

Recommendations:

- Conduct an audit of streetlight types and light levels.
- Conduct a further investigation of dimming technology. If viable and there are no reliability concerns, proceed with a comprehensive retrofit.
- Continue to monitor developments and cost of new streetlighting technologies, piloting new streetlight technologies where opportunities arise.

3.1.5 Information Technology

Although information technology (IT) power is not separately metered, it may comprise 5% or more of electricity consumption. The City has made significant efforts to reduce energy consumption in the past few years, with more changes planned. Energy consumption occurs in three areas: personal equipment (computers, printers, etc), servers, and server cooling equipment.

Personal Equipment. Almost all computers have recently been replaced with new EnergyStar computers and a newer, more energy-aware operating system. All monitors are LCD. The largest remaining measure to reduce consumption is to ensure computers are turned off after hours. In the past this has been hindered by a need to run security and software updates at night. However, by mid-2011 new server and PC software will allow computers to be powered on remotely for updates and security checks. An outreach campaign is planned to inform staff that computers can now be turned off at night, and encourage them to do so.

Servers. There are two server centres, at City Hall and the Fire Hall. About 85% of server capacity has been virtualized to reduce consumption. Plans are underway to virtualize about half the remaining servers, while the rest have to remain independent. Most hardware has been updated to new efficient hardware, with plans to convert the rest. The next big step in server energy reduction would be cloud computing, which transfers server use to the internet. However, this technology is still considered to be in its infancy and there are concerns with privacy and emergency operation. The City has a desire to run a small cloud computing pilot in 2011.

Server Cooling. Servers require significant cooling to remove heat generated. Both server centres are currently cooled with DX cooling equipment. The City Hall server room will be moved and rebuilt as part of the redevelopment of the old library, at which time the waste heat

will be captured for use in the new building. This is an efficient measure to introduce, and should be looked at for the Fire Hall if any renovation work is done there.

Recommendations:

- Continue with plans to upgrade server hardware and virtualization.
- Run an outreach program for staff to shut off computers at night.
- Investigate opportunities to recover waste heat from the Fire Hall servers.
- Initiate a cloud computing pilot.

3.2 Fleet & Equipment

3.2.1 E3 Fleet Review

As part of the update, an E3 (Energy, Environment, and Excellence) fleet review was performed. This review breaks down the fleet by vehicle class and looks at such things as fuel efficiency, utilization, downtime, maintenance, and overall operating cost. It should be noted that the review does not include a physical inspection or take into account the particular use of any given vehicle. Therefore the recommendations for replacement have to be treated with caution and each vehicle assessed individually. However, the E3 review provides valuable information for understanding vehicle and fleet performance. The review summary is provided in Appendix C.

78 vehicles were included in the review, including 18 equipment units. Key performance indicators for the vehicle fleet include:

Table 5: Fleet Key Performance Indicators

Key Performance Indicator	2010 E3 Fleet Analysis
Fleet median fuel efficiency (L/100 km)	30.6
Average utilization (km)	7,526
Average age (years)	6.9
Availability (%)	97.2
Average downtime (days per year)	7.5

Recommendations from the review related to fuel consumption and emissions include:

- Investigate under-performing vehicles to better understand why they are noted as such.
- Improve efficiency through initiatives such as driver training, maintenance and repairs, idling reduction, right-sizing, and trip planning.
- Purchase high-efficiency vehicles if available when replacing vehicles.
- Increase use of alternative fuels and electric technologies.

Some of these measures are discussed further in the following sections.

3.2.2 Driver Training

Poor driving habits such as aggressive acceleration, speeding, and excessive braking can result in significantly higher fuel consumption. Driver training programs can help reduce consumption

while also reducing vehicle maintenance requirements. Reducing idling is a particularly important component of improving vehicle operation. In addition to driver training, there are technical measures that can be taken to improve driving habits, such as speed limiters and fuel consumption feedback to the driver. The City will investigate current City policies and opportunities for driver training programs, ongoing staff engagement programs, and regular training updates, to ensure fuel consumption is kept to the minimum possible and inefficient driving habits are addressed.

3.2.3 Vehicle Maintenance

Regular and correct maintenance of vehicles reduces energy consumption. Such things as air filters, spark plugs, engine oil, and tire inflation all impact fuel consumption, and a regular maintenance program can improve vehicle performance. However, maintenance is performed regularly on the City fleet and improvements in this area are likely to be minimal.

3.2.4 Trip Planning

Scheduling and coordinating tasks can help reduce the number of trips required or the number of vehicles used. Staff may be able to carpool together to job sites, or avoid return trips to the works yard. Current City policy of not allowing seating for more than 2 people in a work truck currently limits the ability to implement carpooling to work sites. Route planning can also help reduce the kms driven on regularly scheduled routes. In addition, considering changes to operational practices such as low maintenance landscape design could help reduce the number of operational trips required or vehicles used.

3.2.5 Vehicle Replacement

Replacement of vehicles should take into account both fuel efficiency and the best choice of vehicle for the use. This includes the primary use of the vehicle, number of people and type of equipment it will be carrying, towing requirements, need for four wheel drive, etc. New “crossover” vehicles may provide alternatives to vans and SUVs. Small, fuel efficient vehicles may also be a better choice than larger hybrids. Attention should also continue to be paid to whether the vehicle is still required, or can be retired without replacement. Both fuel efficiency and vehicle choice can form part of a vehicle purchase policy, which is recommended in Section 3.5.2. Of note, lower emission alternatives for some vehicles, particularly for larger vehicles with a disproportionate impact on the City’s fleet emissions, are currently not available, while other vehicles such as the City’s pool vehicles, which are smaller energy consumers, can be upgraded more readily. Implementation of a robust replacement vehicle policy will ensure the most appropriate vehicle is chosen for the task the vehicle is being used for, and that viable technologies are adopted as they become available.

3.2.6 Alternative Fuels & Electric Technologies

Most vehicles can run on alternative fuels blends such as ethanol or biodiesel without modification. The federal and provincial governments will require 5% renewable fuels in gasoline and 3% in diesel by 2010 (rising to 5% by 2012 and 10% by 2020). There is significant controversy over the potential for bio-fuels such as ethanol and bio-diesel to divert land from food crops and drive up the price of food, along with the fuel used in the production of the biofuel and this should be considered in any decision to use bio-diesel or ethanol. The City is

currently using 5% bio-diesel in most of its diesel fleet and increasing that quantity beyond the provincial standards is not recommended.

Natural gas vehicles have been available for some time, but in the past their reliability has been a concern. New technologies have seen some large scale fleet conversions recently. This is an area that should be watched closely in the future, particularly for heavy duty vehicles to see if these improvements would be worth the considerable cost to convert key units in the City fleet.

Electric vehicles are already available for limited uses, and mainstream electric vehicles will soon be available. They are generally limited to light loads due to battery life. However, there may be certain applications where this type of vehicle could be used in municipal operations, such as bylaw enforcement and pool vehicles. Two electric bicycles and a small electric truck have already been purchased by the City.

Recommendations:

- Utilize the E3 Review to identify underperforming vehicles and take corrective action to assist in identifying vehicles for replacement.
- Initiate a fuel efficiency driver training program.
- Review task scheduling procedures and driving routes to determine if vehicle use can be reduced.
- Ensure that replacement vehicles are both fuel-efficient and the most appropriate vehicle for the use.

3.3 Solid waste

Solid waste contributes approximately 10% of the City's corporate emissions. As noted in Section 2.3, the amount of waste is currently estimated based on volume of waste bins and frequency of pick-up. It is recommended that this methodology be amended to include a visual assessment of the estimated volume of waste bins at all core City facilities at the time of collection to allow for a more accurate assessment of bin volumes. As well as improving annual inventory accuracy, this approach could also be used to re-assess pick-up frequency, resulting in potential cost savings. For example, visual assessments of waste bins at City Hall conducted in the fall of 2010 found that bins were only half full at the time of pick-up, although the City was paying for twice a week service. As a result, the City amended the pick-up schedule to once a week, which has resulted in an annual savings of approximately $1800.

The City has made significant efforts to divert waste in all core facilities. Mixed paper (including office paper and newsprint) and cardboard recycling is provided at all facilities, as is recycling for deposit beverage containers. City Hall provides additional recycling for all blue bin materials (plastics #1,2,4,5, glass bottles and jars, and metal cans) as well as batteries and cell phones.

The recreation centres, particularly John Braithwaite and Harry Jerome have also implemented more extensive recycling programs which have been very successful.

Recently the City conducted a waste audit at City Hall with the help of the North Shore Recycling Program (Appendix D). The purpose of the waste audit was to help identify the quantities and sources of waste generated, and to provide a good approximation

the City's current waste diversion rate. The process involved gathering, sorting and weighing all garbage and recycling generated in one day. City Hall is currently diverting 47% of waste from the landfill. The biggest area of opportunity is composting, as food scraps and other organics make up 34% of the waste stream. Paper towels from washrooms make up a significant component of this, which could be reduced by the use of electric hand dryers. If food scraps and compostable paper were composted at City Hall, a diversion rate of 81% could be reached. With additional improvements in reuse programs and recycling, a diversion rate of 93% could be achieved.

Achieving an increased diversion rate presents many challenges, particularly the need for additional recycling and composting infrastructure to be implemented in City facilities. It is recommended that waste audits be conducted at other core City facilities, particularly the operations centre waste stream, which includes on-street garbage. The process is valuable in identifying sources and quantities of waste, the results of which can be used inform the development of additional waste diversion actions, and help to identify specific recycling programs that would be useful at each facility.

The City's Parks and Public Works groups are also committed to reducing waste and have been working to incorporate more on-site composting in parks and community gardens, as well as setting aside (side-casting) native material for reuse. It is recommended that these procedures continue to be followed where appropriate. Another initiative is the provision of on-street recycling opportunities for residents to recycle items such as newspaper and beverage containers. The City will continue to add more of this infrastructure in the coming years.

Recommendations:

- Conduct visual assessments of waste volumes at all facilities on an annual basis, and adjust pickup frequency as needed.
- Conduct regular waste audits of core facilities to accurately track quantities and sources of waste generated and assess effectiveness of diversion programs.
- Provide food waste collection for food scraps, other organics and compostable paper at all facilities.
- Expand recycling programs at all facilities to include blue bin materials, mixed paper and deposit beverage containers and expand the provision of on-street recycling infrastructure.

3.4 Renewables

There is increasing interest in the use of renewable energy for both power generation and heating. Currently the City is not using any form of renewable energy within its facilities, although LEC owns some solar panels mounted on the new library and is providing geoexchange heating and cooling at the new school district administration building. Although renewable energy is more expensive than traditional energy sources, costs have been decreasing while technology has improved. In addition to reducing energy consumption and GHGs, the use of renewable energy by the City can act as a showcase for the community, allowing the City to show leadership. Renewable energy could also be used by LEC as an indirect way of incorporating renewables into City facilities.

3.4.1 Solar Thermal

Solar thermal is the use of solar energy for hot water and space heating. While this is the most cost effective use of solar energy, it can still have a fairly long payback in many cases. The City has a moderate solar resource with about 1200 sun-hours per year. This is somewhat less than the Okanagan or Peace regions, but similar to much of the province and adequate for use in solar thermal systems.

The best applications for solar thermal are those that have a consistent year round heating requirement and relatively low temperature requirements. Solar is usually used for water heating, as the load is steady year round. Swimming pool applications are ideal, with low temperatures and steady loads. Although solar can be used for space heating, it is not an ideal application as the highest loads occur in the winter, when there is the least solar energy available.

3.4.2 Solar Photovoltaics

Solar photovoltaics (PV) is the generation of electricity from solar panels. While the price of PV has come down recently, it is still a very expensive technology. PV will generally not be cost effective versus electricity from BC Hydro, however it may be cost effective for applications that require significant lengths of distribution wiring (e.g. streetlights, remote signage). PV should be considered for these type of applications as opportunities arise.

3.4.3 Wind

Metro Vancouver is not identified as a major wind resource (such as the Peace region). Any viable wind sites would likely need to be near mountain tops, such as the Grouse Mountain wind turbine. Small scale wind is also usually not competitive with BC Hydro rates. Therefore any wind projects on City buildings would likely be done purely as demonstration projects.

3.4.4 Geo-exchange

Geo-exchange (sometimes called geothermal or earth energy) is the extraction of low temperature heat within the ground through the use of heat pumps. The use of this technology has been growing rapidly in BC. Almost any ground can be used for geo-exchange, but the type of soil will impact the cost and effectiveness of the ground field.

Geo-exchange systems are usually not practical or cost effective to retrofit into existing buildings. They should be considered for any new buildings being constructed. Geo-exchange systems are generally most cost effective when horizontal ground fields can be used (rather than vertical drilling). However, this requires a substantial amount of land area.

3.4.5 Sewage Heat Recovery

Similar to geo-exchange, the heat available in wastewater can be recovered through heat pumps. This technology is relatively new, but has been used in the False Creek district energy system in Vancouver. Its potential was investigated as part of the Harry Jerome charrette and found to not be viable, but there may be better opportunities to incorporate it into the new Works Yard. A prefeasibility study would be required to determine the opportunity to use this technology and could be conducted concurrently with the Works Yard redevelopment process.

3.4.6 Biomass

Biomass is the most common form of renewable energy, used mostly in fireplaces and wood stoves in homes. But it can also be used at a larger scale for heating buildings, using waste wood from mills, construction, or logging operations. Biomass systems using waste wood require on-site operators to ensure smooth flow of the feedstock, limiting their application to larger facilities. Wood pellets can be used with minimal supervision, but are much more costly, particularly with no local pellet manufacturer. For these reasons the use of biomass is unlikely to be practical or cost effective for individual City facilities, but it should be considered for LEC, where economies of scale are much more likely to result in a viable business case.

Recommendations:

- Consider solar thermal for pool water heating in the Harry Jerome redevelopment.
- Consider geo-exchange for the Harry Jerome redevelopment or other new facilities that are planned.
- Work with LEC to evaluate the use of biomass.
- Implement pilot projects to showcase technologies to the public, where feasible.

3.5 Policies

Effective policies are essential to achieving energy reductions and maintaining those reductions over the long term. Policies provide firm guidelines on how energy efficiency is to be achieved and maintained. They give staff the authority to incorporate energy efficiency measures and ensure that efficiency is not forgotten or pushed aside by competing interests.

Good policies should be clear and straightforward to both understand and execute. They should be rigorous enough to have an impact, yet flexible enough to not lock the City into decisions that do not make sense. Policies may cover the operation of existing assets as well as the construction/purchase of new facilities or equipment. Procedures should be in place to ensure on a regular basis that staff are aware of the policies and are implementing them.

Although this plan deals with energy and GHG emissions, other environmental attributes may also be included. However, a policy should not try to cover so many things as to become unwieldy.

The City already has many policies in place related to energy and GHG emissions. Some of these should be updated, while additional policies can be developed.

3.5.1 Buildings

The City has a policy in place to target LEED Gold with a minimum of LEED Silver for all new buildings or major renovations over 10,000 ft². This policy provides a reasonable target while providing flexibility. The policy does not cover smaller buildings, due to the cost of LEED compliance. LEED has recently added the ASHRAE Advanced Energy Design Guides and NBI Core Performance Guide as alternative compliance paths for small buildings. The City could adopt the use of these guides as a policy for buildings under 10,000 ft². Alternatively, the City could develop its own list of prescriptive measures for small buildings.

While major renovations are covered by the policy, smaller renovations or ongoing maintenance projects are not. Including a policy to cover these situations can help ensure that opportunities are not missed while making changes to the building or performing regular maintenance. An example would be to require light level measurements to be taken and new T8 lamps and electronic ballasts to be used any time a light fixture or ballast is replaced. Other things to be incorporated in the policy would include high efficiency motors, heating and cooling equipment, windows, insulation upgrades, and low flow water fixtures.

3.5.2 Vehicles

There are no specific energy efficiency policies related to vehicles, although the Sustainable Purchasing Policy would cover vehicles. There are, however, some existing policies that appear to limit opportunities to reduce vehicle emissions. Limitations on purchasing four seat pickup trucks has been identified as a barrier to more efficient use of vehicles. These policies should be reviewed to determine if they could be amended, with an understanding of their impact on vehicle emissions.

The Sustainable Purchasing Policy calls for staff to develop performance specifications or selection criteria for specific purchases. For vehicles, these specifications can outline specific requirements such as selecting from the top efficiency quartile and not purchasing vehicles larger than actually required. While it is important to maintain flexibility in vehicle purchasing, the individual making the purchase should justify any deviation from the policy through the use of a decision matrix and by providing the energy/GHG implications of the decision.

3.5.3 Equipment

Equipment purchases are covered under the Sustainable Purchasing Policy. This policy outlines how decisions are to be made in the selection of goods and services, but does not specify specific energy efficiency requirements. The policy does indicate that staff are expected to develop performance specifications or selection criteria.

Most major equipment intended for indoor use (computers, printers, refrigerators, etc.) have Energuide consumption ratings, and are also available with EnergyStar ratings. EnergyStar identifies equipment that meets a higher efficiency standard than typical. This is an international standard with very good recognition. EnergyStar ensures cost effectiveness, availability, and is ideal as selection criteria for a purchasing policy.

Gas-fired lawn and garden equipment produces higher GHG emissions than electric equipment, and much higher levels of air contaminants. Where possible, electric equipment should be chosen over gas or propane.

3.5.4 Solid Waste

The City has two policies related to solid waste – the e-government strategy and the Sustainable Print Policy. The e-government strategy seeks to reduce the amount of paper used by providing more electronic services, while the Sustainable Print Policy aims to minimize paper use and maximize recycled content.

The City should consider introducing a zero-waste meeting policy (e.g. paperless systems, reusable mugs and plates). This would help further reduce paper use and garbage production, while also acting as a high profile staff awareness initiative.

Recommendations:

- Add criteria for small buildings and renovations to the LEED Standards for City of North Vancouver Buildings policy.
- Develop criteria for vehicle purchases and provide documentation.
- Develop selection criteria for equipment purchases based on EnergyStar.
- Adopt a zero waste meeting policy.

3.6 Staff Awareness

3.6.1 Staff Input into Plan Development

A key component of this plan was to engage with City staff to provide the opportunity for all staff to inform the plan's development, and to create corporate-wide awareness and interest towards the plan's goals and objectives. In-depth interviews were held with all Directors, Department Managers and key staff at all City facilities to obtain their input. Information sessions were also held with key groups responsible for larger energy use, and a questionnaire was circulated to staff at all City facilities to ensure everyone had the opportunity to provide feedback. The key outcome of this engagement was to obtain staff input regarding opportunities and challenges for reducing energy and emissions in the City's municipal operations. Information obtained through the process has been incorporated into the plan to inform the development of specific actions for reducing energy, emissions and waste.

Key opportunities that were identified and incorporated into the plan include: improving efficiency and reductions in the buildings, fleet and waste sectors, enhancing detailed and accurate data collection and reporting, considering the use of new technologies, and providing incentives to encourage carpooling, bicycle and transit use. Key challenges that were identified include: operational challenges such as a lack of staff resources and money to implement projects, financial challenges such as a lack of emphasis on energy projects in the budget process, and policy and governance challenges such as carpooling limitations. A detailed summary of staff engagement results is provided in Appendix E.

3.6.2 Development of Staff Behaviour and Awareness Program

The second element of the staff engagement process was to obtain staff input regarding the most effective tools and channels of communication to inform the development of an ongoing staff behaviour and awareness program. A key recommendation of the Corporate Climate Action plan is to formalize a staff behaviour and awareness program to further develop and reinforce existing efforts in energy conservation and waste reduction over time, communicate best practices, and demonstrate corporate leadership in climate action.

The recommended staff behaviour and awareness program is guided by community-based social marketing principles: maximizing benefits and minimizing barriers to sustainable behaviour, with an emphasis on developing vivid, clear messages and images that illustrate key motivators such as quality of life and cost savings. The focus is on actions that generate positive results, which can be attained through linking with activities staff are already doing, leveraging existing initiatives, and integrating climate action into current work plans. The goal is to effectively engage staff throughout the organization with respect to why and how climate

action is relevant for their individual roles, to foster ownership for achieving energy and emissions reductions in all departments, and to demonstrate civic leadership by providing examples of projects, actions or technologies that could be achieved in the broader community.

Key themes regarding ongoing communication and awareness identified during the consultation with staff include: a lack of dedicated staff resources for ongoing engagement and awareness; challenges to behaviour change and lack of communication and coordination among all City facilities; the need for meaningful reporting and feedback on the City's progress and savings achieved through reduction actions; the effectiveness of visible displays and demonstrations of energy use and City initiatives at all facilities; the need for increased education and training opportunities for all levels of staff; and enhanced support for energy champions and providing recognition, incentives and rewards for action.

Some of the specific opportunities and actions that were identified are summarized in the table below:

Table 6: Staff Engagement Themes

Themes	Proposed Actions
Energy efficiency	• Reduce individual energy use (computers, monitors, heaters, coolers, fans, etc.) through education programs • Manage computer data storage (emails and documents) to reduce energy need and cost. • Conduct jobsite audits to assess opportunities for energy and waste reduction.
Employee commuting and fleet efficiency	• Encourage better use of car-pooling to sites. • Encourage use of electric bicycles instead of personal vehicles. • Provide driver training for safety and fuel efficiency. • Implement telework initiatives • Provide staff commuting incentives and disincentives.
Waste reduction	• Monitor and report on printing and paper use and initiate paper reduction initiatives. • Encourage waste reduction through monthly challenges (i.e. waste-free meetings, waste-free lunches).
Promotional events	• Promote corporate involvement in events such as Earth Day and Ride Share Week.

Staff behaviour and awareness programs are critical to the success of reduction activities such as driver training or recycling. In addition to reducing overall energy consumption in buildings by over 5%, experiences at other organizations such as the City of Vancouver and the University of British Columbia demonstrate that these programs also build morale and a strong sense of community.

Recommendations:

- Develop and provide funding and resources to implement an ongoing staff behaviour and awareness program.

4. Meeting Carbon Neutral Requirements

The commitment to carbon neutrality requires a reduction in energy consumption as well as the purchase of carbon offsets for any remaining emissions. Carbon offsets are investments made in other GHG reducing projects. These projects are generally more cost effective than projects a municipality could undertake, so the cost per tonne of CO_2 is relatively low (typically $15 – $30/tonne). But carbon offsets must be purchased every year, with potentially rising costs, whereas money invested in energy reductions will pay back over time through reduced operating costs. Therefore it is preferable to maximize cost effective reductions over the purchase of offsets.

Offsets are generated from a number of different types of projects. These can include energy efficiency, renewable energy generation, landfill gas capture, forestation, etc. Offsets have been somewhat maligned through reports of companies selling dubious offset projects. However, offsets are an innovative financial mechanism that can greatly reduce GHG emissions and without offsets it will be very difficult for most organizations to make deep reductions. With increasing regulatory requirements for GHG reductions, the oversight and regulation of offsets will increase.

For an offset to be considered valid, it must be additional. This means that it would not have gone ahead anyway without the sale of offsets. Other important factors in assessing the quality of offsets are third party verification, uniqueness (the offset is only counted once), permanence, and leakage (where the project results in an increase in emissions elsewhere). There are a number of standards available for assessing offset projects, of which the Gold Standard is probably the highest, supported by organizations such as the World Wildlife Fund and the David Suzuki Foundation.

The Province's Green Communities Committee (GCC) is developing requirements for offsets under the Climate Action Charter. While these have not been finalized, they did provide an overview of likely options at the 2010 UBCM conference:

1. **Purchase offsets from the Pacific Carbon Trust (PCT) or another vendor.** The PCT was set up by the provincial government to invest in GHG offset projects in British Columbia. Originally set up to provide offsets to government and crown corporations, PCT is now selling to local governments and companies. Offset projects are regulated by the BC Emission Offsets Regulation and can be considered to be high quality. The current purchase price is $25/tonne.

   Besides PCT, there are at least 14 other offset vendors in Canada and over 140 internationally. The quality of offsets available ranges considerably. The David Suzuki Foundation and Pembina Institute have released a report that grades the Canadian offset vendors and six international vendors. Vendors are ranked and grouped into strong, average, and weak performers. This list is an invaluable resource if offsets are to be purchased from a vendor other than PCT. The cost of offsets at the top ranked Canadian vendors ranges from $20 to $47.50/tonne.

2. **Invest in a GCC supported local project.** This option has been developed as an alternative to purchasing offsets, as a response to communities' concerns about keeping offset money in the community. The GCC will develop a list of eligible projects and a method for estimating GHG reductions. Projects would be outside the municipality's

corporate operations. Projects initially identified for potential inclusion are vehicle fuel switching, energy efficiency retrofits, solar water heating, and organic waste diversion. It should be noted that these types of offset projects would probably not meet the verification and incrementality requirements of Gold Standard offsets. As well, the cost for these projects is likely to be much higher than $25/tonne, although there may be other benefits to the project.

3. **Invest in another local project.** Local governments may submit a project proposal to GCC for other offset projects. The projects will have to satisfy GCC requirements, similar to Option 2 above. The same issues of quality and cost apply. There will be additional work required to gain approval from GCC, as compared to Option 2.

As well as the options outlined by GCC, there are some other offset alternatives:

4. **Develop or invest directly in a verified offset project.** By investing in a large-scale verified project, the City could obtain offsets for corporate operations as well as generate revenues by selling the remaining offsets to PCT or another vendor. Presumably any verified project would also meet GCC's requirements, although this has not been confirmed. However, developing such a project would be difficult. Projects are usually quite large in order to achieve economies of scale and require large capital investments. Verified projects such as renewable energy require significant expertise and can take years to develop. There are not likely to be viable offset projects involving the City's own operations (although forestation might be a possibility) but there may be potential for local projects outside the City's operations.

5. **Develop or invest in a renewable energy project for LEC.** While it might seem logical to invest offset dollars into LEC (which is owned by the City but falls outside it corporate operations), there are some difficult issues. If LEC sells or gives carbon credits to the City, it cannot claim them for itself. Therefore LEC's emissions factor would not go down. If LEC is allowed to keep the carbon credits, then they can't be used to offset the City's corporate emissions. One option would be for LEC to develop a renewable energy project and sell some of the offsets to the City, keeping the rest. While the benefit to LEC's emissions factor would be reduced, they would keep the energy cost savings and some of the emissions benefits. Such an arrangement would probably need to be approved by GCC.

6. **Carbon Reserve Fund.** A carbon reserve fund is a fund set up by the local government to which money is contributed for the purpose of investing in local projects that reduce GHGs, with no direct link between the money invested and the GHG reductions obtained. This concept was first developed by the City of Saanich prior to the Climate Action Charter. These are not true offsets, as there is no guarantee (and little likelihood) that the money can achieve the same level of GHG reductions as large-scale offset projects. However, it does keep the money within the community, or within the City's facilities if so designated. Funds would be set aside at the same rate as the PCT ($25/tonne). This type of arrangement will probably not be allowed by GCC in the future.

The City will need to consider these options in the near future, once the GCC guidelines are finalized. If the intention is to invest in a local offset project, it could take a number of years to develop and initial planning should start immediately. The timeline for detailed guidelines from

GCC is not known and may come too late for 2012 budgeting, which may limit the ability to develop local offset projects in the first few years.

Recommendations:

- Develop a corporate strategy for offsets to meet the Carbon Neutral Local Government commitments.

5. Objectives and Targets

5.1 Objectives

The 2005 Action Plan incorporated both corporate and community objectives under eight overall objectives. Having the community and corporate objectives combined can be challenging, and since the community portion of the plan has since been updated separately, a new set of corporate objectives has been developed.

The OCP contains a number of energy related policies and actions. While these are primarily aimed at community-wide energy consumption and emissions, they are instructive in forming the corporate objectives. The relevant OCP policies are as follows (summarized):

Policies:

- Improving the efficiency of new and existing buildings.
- Displacing old, inefficient heating systems with high-efficiency and renewable heating systems.
- Minimizing vehicle use and encouraging alternative transport modes.
- Expansion of LEC.
- Transition to more renewable energy sources, both on-site and through LEC.
- Waste minimization.

Actions:

- Aggressive energy standards for new and existing buildings.
- Building retrofits – to achieve a 3% annual retrofit rate per year.
- 100% of City buildings on LEC by 2020.
- Best practises for renewable energy in buildings.

New corporate objectives have been developed to address each sector. In addition there are two overall objectives. The intent is that each objective is SMART – Specific, Measureable, Attainable, Relevant, and Time-bound. Therefore each objective includes a target and indicators, and the supporting actions (with timelines and responsibility) outlined in Section 6.

Table 7: Corporate Objectives

	Objective	Target	Indicators	Actions
Overall	Show leadership and innovation by showcasing technologies and best practises.		Number of demonstration projects	2.8, 2.12, 5.2
	Engage staff regarding energy conservation and waste reduction, and develop an ongoing mechanism to support and reinforce efforts over time.		Budget in place for staff education, number of events and programs	2.10, 7.1
	Encourage alternative transport modes for employee commuting.	20% reduction in staff driving SOV to work by 2020.	% of staff driving SOV to work	7.1
Buildings & Renewables/LEC	Reduce energy consumption in existing facilities.	25% reduction by 2020	GJ, kWh - % reduction GJ/kWh per capita	2.1, 2.2
	Reduce energy consumption in new facilities beyond current energy codes.	25% above code	Number of LEED energy points, energy use per ft²	2.3, 2.4
	Connect all City-owned buildings over 1000 m² to LEC.	All by 2020	Number and % of civic floor space connected	2.2, 2.4
	Increase the use of renewable energy, both on-site and through LEC.	5% of energy from renewables by 2020.	% GJ from renewable sources	2.4
Fleet	Increase fleet efficiency and reduce GHG emissions.	30% reduction in consumption per km by 2020.	Fleet average L/100 km	3.1, 3.2, 3.4
	Reduce fleet km.	5% reduction in fleet km by 2020.	Total fleet km km/capita	3.3
Solid Waste	Reduce solid waste going to the landfill.	33% reduction in waste by 2020.	Tonnes of solid waste Diversion rate	4.3, 4.4

5.2 Targets

The commitment to carbon neutrality made under the Climate Action Charter is a two part process, requiring a reduction in GHG emissions followed by the purchase of offsets for any remaining emissions. Although offset purchases will meet the requirements of the Charter, maximizing emissions reductions is the real intent. Emissions reductions also result in energy cost savings for the City, whereas offsets are an increased cost that will grow over time.

Setting a reduction target will provide a goal and a timeline for reducing consumption. Targets can be pragmatic or visionary. Pragmatic targets are developed based on a detailed assessment of opportunities and available technologies. Visionary targets set a goal for reductions based on the perceived need, and actions are then driven by the target. In practise most targets are a combination of both.

There are many opportunities for reducing energy consumption and emissions within the City's corporate operations, as outlined in Section 3. Although precise savings estimates have not been calculated, the following are estimates of the savings potential by sector, through retrofits or technology choices:

Table 8: Savings Estimates by Sector

Sector	GHG Reduction	Notes
Existing Buildings	10 - 30%	Based on opportunity assessment of largest buildings.
New facilities	0 – 90%	Dependant on level of performance targeted for new buildings, particularly Harry Jerome.
Streetlights	0 – 50%	Savings are likely to be minimal until technology changes and price reductions occur.
Information Technology	15 – 30%	Savings depend on staff response to outreach.
Fleet & Equipment	15 – 50%	Minimum savings from gov't legislation.
Solid Waste	15 – 40%	Assumes organics collection, savings depend on participation.
Overall	**4% - 34%**	**From current (2009) emissions levels.**

The existing target is based on a 1995 baseline. However, the 1995 inventory is missing some data and its methodology is not consistent with more recent inventories. For better consistency as well as alignment with the City's community-wide GHG reduction targets, the use of 2007 as a baseline is recommended.

As the City has positioned itself as a leader in confronting climate change, the target should be somewhat visionary. However, it is important that it also be achievable, particularly considering that the previous target was not achieved. A reduction target of 25% relative to 2007 will provide a balance between optimism and pragmatism. While a 25% reduction is aggressive, it should be achievable with the successful implementation of this plan.

Interim targets are also recommended to track progress towards the 2020 target. Interim targets of 5% by 2013 and 15% by 2016 are recommended.

Recommendations:

- Set a GHG reduction target of 25% by 2020, relative to 2007 emissions.
- Set interim GHG reduction targets of 5% by 2013 and 15% by 2016, relative to 2007 emissions.

6. Recommended Actions

The following are the key recommended actions. The recommended timeframe for implementation is relatively short, in order to maximize reductions and savings prior to 2012, the

carbon neutral commitment year. Responsibility for implementing each action has also been identified.

Table 9: Recommended Actions

Action		Timeframe	Responsibility
1.1	Monitor and report annually on energy consumption, GHG emissions, and indicators.	Ongoing	Community Energy Manager, All
Buildings & Infrastructure			
2.1	Determine future building plans and undertake a comprehensive project to retrofit all buildings.	2012 - 2014	Facilities, NVRec
2.2	Connect buildings to LEC.	2011 - 2018	Facilities, LEC, NVRec, Planning
2.3	Make energy efficiency and GHG emissions a priority for the Harry Jerome upgrade or redevelopment. Target total GHG emissions of at least 25% lower than emissions of the existing facilities.	TBD	Planning, NVRec
2.4	Work together with LEC to identify and support renewable alternatives in LEC's system, particularly in the Harry Jerome redevelopment.	Ongoing	Facilities, NVRec, LEC
2.5	Encourage LEC to publish an annual emissions factor and set a target for lowering their emissions factor over time.	2011	LEC
2.6	Conduct an audit of streetlight types and light levels.	2012	Traffic and Transportation
2.7	Conduct a further investigation of streetlight dimming technology. If viable and there are no reliability concerns, proceed with a comprehensive retrofit.	2012 - 2016	Traffic and Transportation
2.8	Continue to monitor developments and cost of new streetlighting technologies, piloting new streetlight technologies where opportunities arise.	Ongoing	Traffic and Transportation
2.9	Continue with plans to upgrade server hardware and virtualization.	Ongoing	IT
2.10	Run an outreach program for staff to shut off computers at night.	2011	IT, Green Team
2.11	Investigate opportunities to recover waste heat from the Fire Hall servers.	2011 - 2012	IT, Facilities
2.12	Initiate a cloud computing pilot.	2011 - 2013	IT
Fleet			
3.1	Utilize the E3 Review to identify underperforming vehicles and take corrective action to assist in identifying vehicles for replacement.	2011	Public Works, Fire
3.2	Initiate a fuel efficiency driver training program.	2012	Public Works, Parks
3.3	Review task scheduling procedures and driving routes to determine if vehicle use can be reduced.	2012	Public Works, Parks
3.4	Ensure that replacement vehicles are both fuel-efficient and the most appropriate vehicle for the use.	Ongoing	Public Works, Fire

Solid Waste			
4.1	Conduct visual assessments of waste volumes at all facilities on an annual basis, and adjust pickup frequency as needed.	Ongoing	Community Energy Manager, Facilities
4.2	Conduct regular waste audits of core facilities to accurately track quantities and sources of waste generated and assess effectiveness of diversion programs.	Ongoing	Facilities, Community Energy Manager
4.3	Provide food waste collection for food scraps, other organics and compostable paper at all facilities.	2013	Facilities, Public Works
4.4	Expand recycling programs at all facilities to include blue bin materials, mixed paper and deposit beverage containers and expand the provision of on-street recycling infrastructure.	2012	Facilities
Renewable Energy			
5.1	Consider best available renewable energy source for future facilities or upgrades (e.g. solar thermal for pool water heating and geo-exchange for space heating/cooling in the Harry Jerome redevelopment).	Ongoing	Facilities, LEC, Planning
5.2	Work with LEC to evaluate the use of biomass heating.	2012	Facilities, LEC
5.3	Implement pilot projects, where operationally feasible, to showcase technologies to the public.	Ongoing	All
Policies			
6.1	Add criteria for small buildings and renovations to the *LEED Standards for City of North Vancouver Buildings* policy.	2011	Facilities
6.2	Develop criteria for vehicle purchases and provide documentation.	2011	Purchasing, Public Works
6.3	Develop selection criteria for equipment purchases based on EnergyStar.	2011	Purchasing
6.4	Adopt a zero waste meeting policy.	2011	Community Energy Manager, All
Staff Awareness			
7.1	Develop and provide funding and resources to implement an ongoing staff behaviour and awareness program.	2011 - 2013	Community Energy Manager, Facilities

7. Implementation

7.1 Budget

To achieve the targeted reductions, a financial investment will be required. This applies to capital projects as well as planning and studies. No detailed cost estimates have been performed, but the following are rough estimates for some of the main actions that can be used to guide budgeting decisions. These will need to be further refined prior to proceeding with

action implementation. There will also be staff time required to implement the actions, estimates for which have been included.

Budgeted costs are based on key measures that are focused on energy and GHG reductions. Other City initiatives that result in energy savings but are not primarily energy efficiency projects are not included (e.g. renewal of City Hall building envelope). Actions that are expected to occur anyway (such as IT upgrades or vehicle replacements), without a premium cost for energy efficiency, have not been included. As well, no costs have been included for energy efficiency in new or upgraded buildings such as the Harry Jerome redevelopment. It should be noted that many expected efficiency improvements for vehicles have not yet been brought to market and therefore cost premiums for these technologies are not known. A 10 – 20% premium for these technologies has been assumed, once they gain market acceptance.

Table 10: Budget

Action	Budget	Timeframe	Notes
Building retrofits	$800,000 – $1,000,000	2 – 3 yrs	Includes staff time allocation.
LEC connections	$250,000 – 400,000	1 – 5 yrs	Connection fee and internal costs. LEC's infrastructure costs are not included.
Streetlight retrofits	$200,000 - $300,000	3 – 5 yrs	If technologies prove to be viable.
Fleet	$65,000 - $130,000	Annually	Depends on vehicles selected.
Staff awareness activities, expanded waste diversion, miscellaneous studies, pilots, monitoring, etc.	$85,000 - $150,000	Annually	Cost for incentives, materials. Includes staff time allocation.
Total	**$2.0 – $3.1 million**	**5 years**	

The City can expect to see energy cost reductions of $300,000 - $350,000 (current energy prices) by achieving the 25% reduction target, providing a simple payback of 6 to 10 years. However, it should be noted that the relationship between cost and savings is not linear. While there is some overlap between expenditures and savings, the level of savings achieved will depend greatly on such factors as the scope of the building retrofit, policy implementation, staff engagement, and viability of technologies. The budget range indicates the likely budget required to achieve the 25% target .

7.2 Financing / Funding

An important consideration in funding energy efficiency projects is to understand that capital investments will be paid back through lower energy costs. If funds are borrowed with a financing term equal to the project payback, there will be no net cost to the City or to taxpayers. Grant funding may be available for some of the actions from a variety of sources. It should be noted that it can be more difficult to obtain funds for energy efficiency projects than it was in the past. There are fewer programs available and more communities vying for funding. Possible funding sources are listed below:

Table 11: Potential Funding Sources / Programs

Action	Potential Funding Sources
Building retrofits	BC Hydro Power Smart Terasen Gas Green Municipal Fund
Streetlight retrofits	BC Hydro Green Municipal Fund
Renewable energy	Green Municipal Fund Eco-energy for Renewable Power
Natural gas vehicles	Fortis BC

7.3 Performance Monitoring and Reporting

Monitoring and reporting is an important aspect of successfully implementing the plan. Procedures are already in place for updating the inventory and reporting results to Council on an annual basis. In 2010 the City became only the 3rd municipality in Canada to complete Milestone 5 (Monitoring and Reporting) for both corporate and community emissions under the PCP program.

It is recommended that annual monitoring and reporting be formally adopted as a City policy. The indicators associated with the objectives in Section 5.1 should be incorporated into the City's regular monitoring and reporting activities. The City should also undertake the improvements to inventory data collection identified in Section 2.3.

8. Conclusions

The City of North Vancouver has made a commitment to carbon neutrality in their corporate operations by signing the Climate Action Charter. To meet that commitment, the City will need to reduce energy consumption and GHG emissions, as well as offset any remaining emissions.

There are a variety of opportunities available for reducing energy consumption in the City's operations, including building retrofits, driver training and trip planning, purchasing policies for vehicles and equipment, and staff engagement. By implementing these opportunities, the City can target emissions reductions of 25% by 2020. To do so, it will be necessary to budget for implementation activities, with a recommended budget of $2.0 - $3.1 million over the next 5 years. The City can expect to see energy cost reductions of $300,000 - $350,000 (current $) by achieving the 25% reduction target, providing a simple payback of 6 to 10 years.

Success in achieving the targeted reductions will depend on a number of key factors, including:

- Undertaking a comprehensive retrofit of remaining building retrofits.
- Connecting buildings to LEC, even if the future use is unknown. Heat exchangers and piping can be re-used should the building be demolished or significantly renovated.
- Ensuring that any redevelopment of Harry Jerome is built to a very high standard of efficiency, targeting lower energy consumption than the existing buildings.
- An effective vehicle replacement policy that ensures fuel consumption is reduced as new vehicles are purchased.

- An effective, ongoing staff behaviour and awareness program.

There are a variety of means of offsetting the City's remaining emissions, including the purchase of offsets or investing in a local offset project. It is recommended the City explore local offset opportunities once the GCC guidelines are released.

Appendices

A - Opportunity assessment for buildings
B - Harry Jerome overview
C - E3 Fleet assessment
D - City Hall waste audit
E - Staff engagement results

Enerficiency
CONSULTING

Appendix A

Energy Efficiency Opportunity Assessment
of
Corporate Buildings

City of North Vancouver

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February, 2011

1. Introduction

An opportunity assessment is an initial survey of facilities and their energy bills in order to determine the potential scope of a comprehensive energy efficiency retrofit. The opportunity assessment includes a review of the energy bills, a short walk-through of key facilities, and discussions with staff. From the information gathered, broad estimates of potential energy savings and project costs are made, and a financial analysis is performed.

The purpose of the opportunity assessment is to indicate to staff and council/board the potential benefits, both financial and otherwise, from undertaking a comprehensive energy efficiency project. It should be understood that an opportunity assessment is NOT a comprehensive energy audit or study, and does not take the place of an engineering study. Rather, the opportunity assessment allows local governments to make informed decisions about if and how to proceed with more detailed assessments.

Comprehensive Energy Efficiency Retrofits

Energy efficiency retrofits projects provide a number of benefits to local governments. In addition to the savings in utility expenditures, there are potential benefits from improved occupant comfort, replacement of aging equipment, and reduced maintenance expenditures. There is also the opportunity to show leadership within the community in taking action on climate change, as well as working towards carbon neutral commitments made under the Climate Action Charter.

Often organizations only choose to undertake low cost, short payback measures, or to proceed slowly, one project at a time. A comprehensive retrofit aims to greatly improve the efficiency of all or most of the organization's facilities in a single project. Although this will require a larger capital investment and may have longer paybacks, there are many benefits to this approach, both financial and otherwise:

Financial implications. Energy efficiency projects are an investment opportunity for local governments. By delaying projects, or choosing only short payback measures, local governments miss out on these opportunities. Energy efficiency projects should be evaluated in financial terms, over the project life cycle. When you do so, implementation delays or reduced scope will result in a lower net present value. Comprehensive retrofits provide a greater financial return to the local government in the long run.

Economies of scale. Larger projects can result in lower costs. Large projects will gather more interest from contractors bidding the job, resulting in more competitive bids. Larger quantities of equipment (such as lamps and ballasts) will result in supplier discounts and a large project will result in lower consulting fees than multiple small projects. And although a comprehensive retrofit may require more staff time initially, it will mean less staff time is required over the long term in comparison to managing many small projects.

Equipment renewal. Replacing old inefficient equipment not only saves energy, it also upgrades equipment that may need to be replaced soon anyway. A good example is aging boiler plants. By using energy savings to pay for the upgrade, future capital expenditures can be avoided. Allowing for longer paybacks means more equipment renewal can be incorporated into the project.

Cash flow neutral. Energy efficiency projects are cash flow neutral. That means the cost of financing the project is covered by the reduction in operating costs. So a comprehensive retrofit project can be financed with no impact on local government budgets or taxpayers. Small projects tend to come out of current budgets, although they still result in lower operating costs down the road.

2. Facilities

This opportunity assessment examined 13 of City of North Vancouver's buildings. These facilities account for nearly 90% of GHG emissions from City facilities. Energy consumption data and other information was provided by staff. All the buildings had a quick walkthrough site visit to look for potential savings opportunities. The buildings are summarized below:

Building	Area (ft^2)	Annual Energy Cost
RCMP	116,057	$124,130
Fire Hall	20,003	$ 32,385
City Hall & Library	42,437	$ 87,035
New library	36,423	$ 55,917
City Works Yard	18,098	$ 39,343
Presentation House	15,602	$ 19,236
NS Neighbourhood House	19,600	$ 20,906
Mahon Park Facilities	6,865	$ 14,385
John Braithwaite	34,755	$ 60,136
Mickey McDougall	22,467	$ 14,165
Harry Jerome	90,018	$167,513
Centennial Theatre	29,095	$ 40,167
Memorial Gym	20,691	$ 21,188

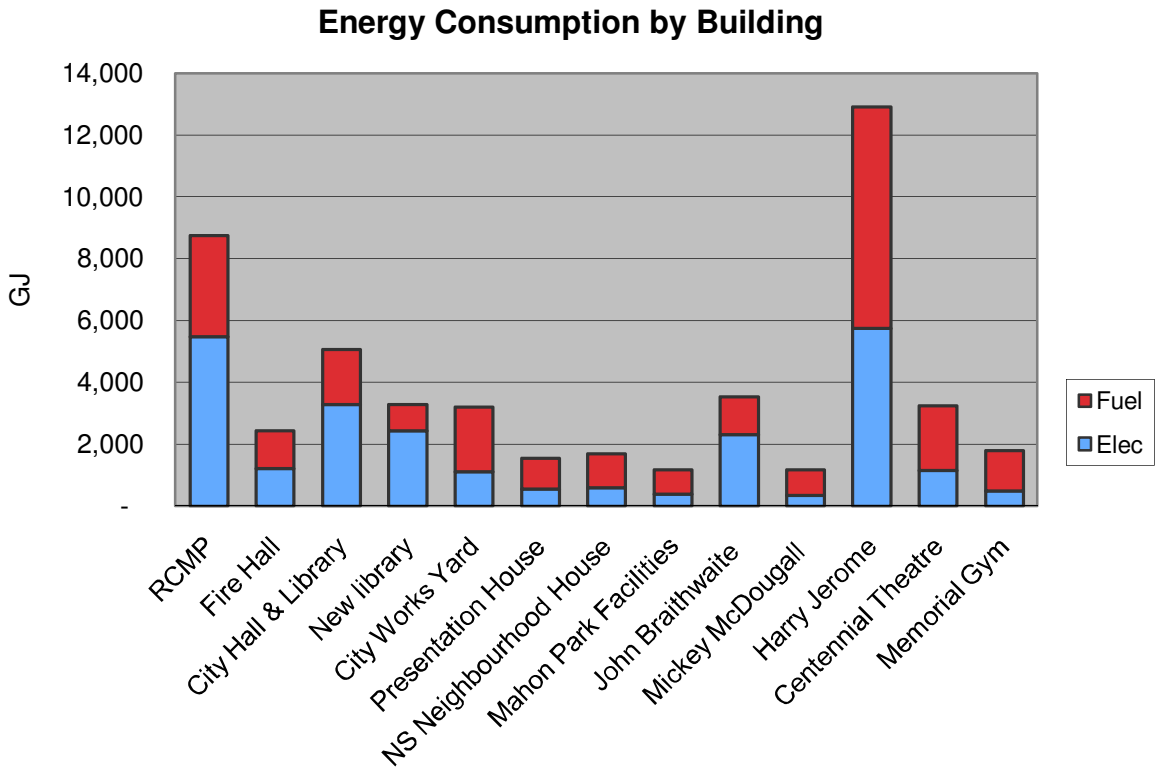
3. Current Energy Consumption and GHG Emissions

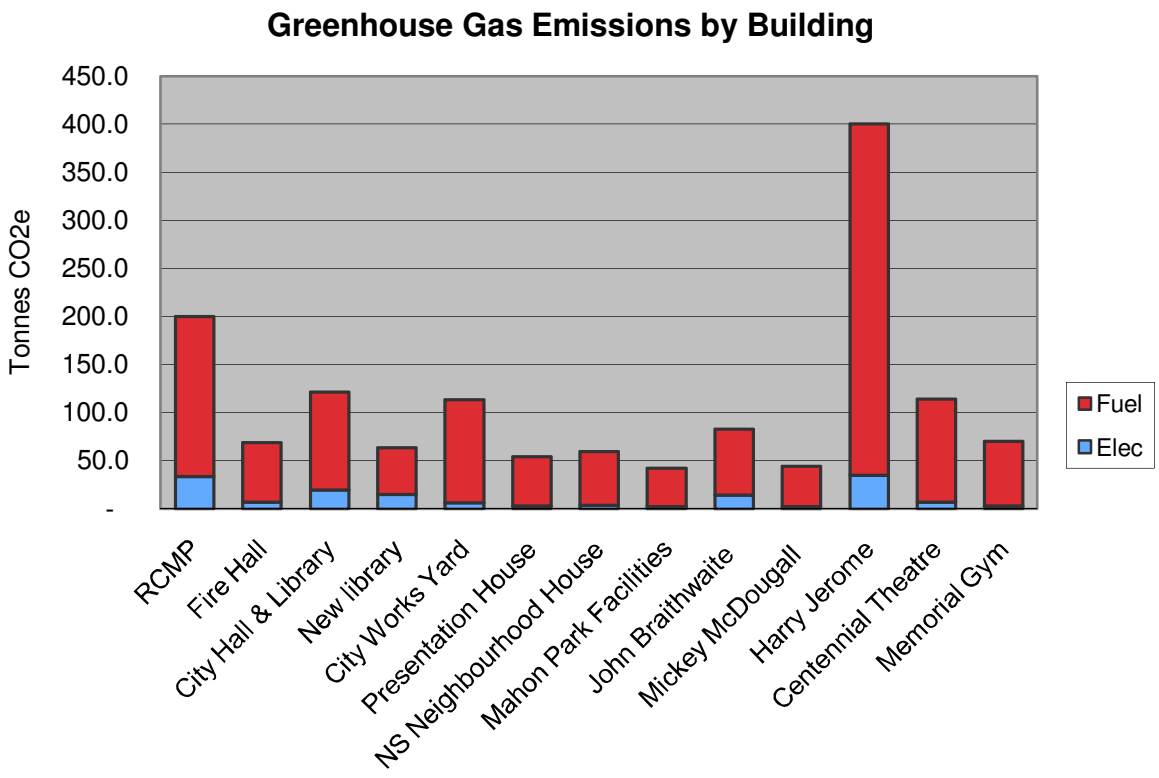
Total energy consumption for the facilities is 49,847 GJ and $696,506 annually. Electricity consumption is 6,970,470 kWh and $418,228 , while fuel consumption is 24,755 GJ and $278,278 . Ten of the buildings use natural gas as the primary heating fuel, while three use district hot water from Lonsdale Energy Corporation (LEC). Total greenhouse gas (GHG) emissions are 1,438 tonnes CO2e, 89% from fuel combustion.

The largest energy consumer is the Harry Jerome recreation centre, accounting for a little over one quarter of consumption. The RCMP is also a major consumer, at 18% of total energy. The remaining buildings each account for 10% or less of the total. Production of GHGs is similar to energy consumption, with Harry Jerome and the RCMP accounting for nearly half of the total.

Energy intensity, in terms of consumption per unit area, is a useful way of comparing buildings to other similar facilities, although not applicable to all building types. The most energy intensive facility is the City Works Yard, which has an energy intensity of 49 ekWh/ft^2, while other energy intensive buildings include the Mahon Park buildings and Harry Jerome. However, most of the buildings do not have particularly high energy intensities when compared too typical facilities of similar use. Only the Public Works Yard stands out as

being significantly higher than typical. The recreation facilities generally have quite low intensity compared to typical, including Harry Jerome.




Greenhouse Gas Emissions by Building
Tonnes CO2e
450.0
400.0
350.0
300.0
250.0
200.0
150.0
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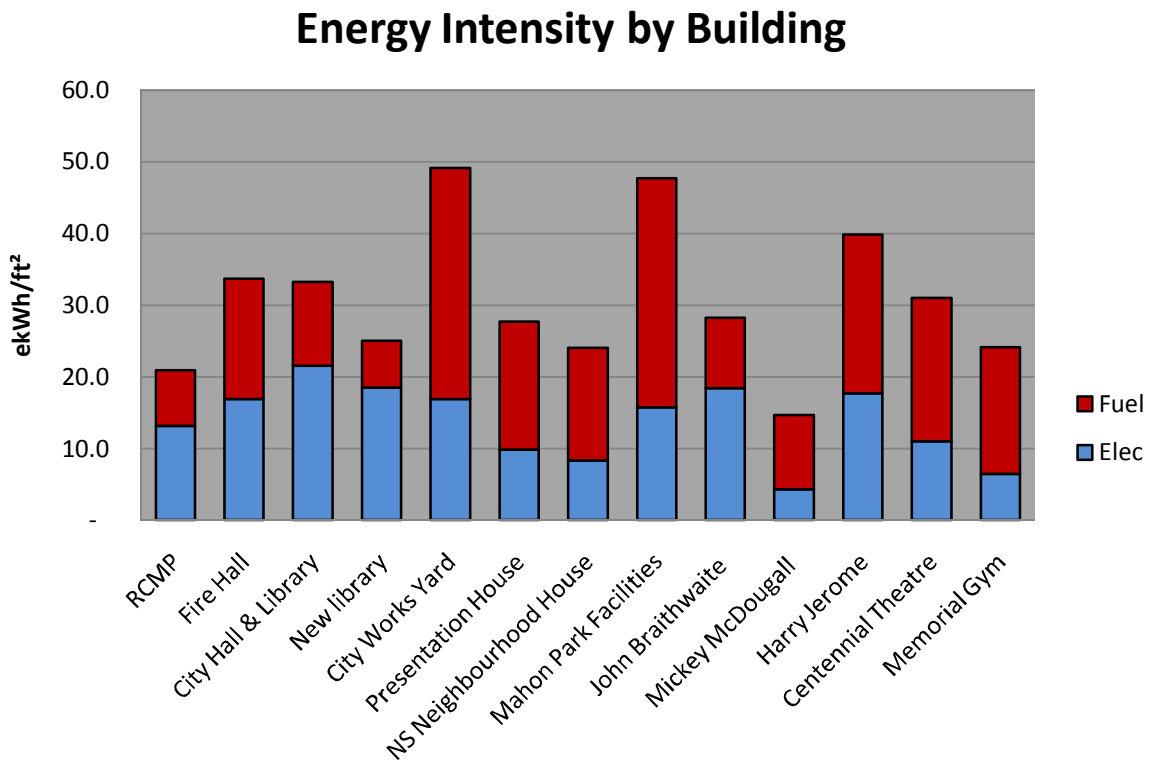
RCMP
Fire Hall
City Hall & Library
New library
City Works Yard
Presentation House
NS Neighbourhood House
Mahon Park Facilities
John Braithwaite
Mickey McDougall
Harry Jerome
Centennial Theatre
Memorial Gym
Fuel
Elec


Energy Intensity by Building
ekWh/ft²
60.0
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Fire Hall
City Hall & Library
New library
City Works Yard
Presentation House
NS Neighbourhood House
Mahon Park Facilities
John Braithwaite
Mickey McDougall
Harry Jerome
Centennial Theatre
Memorial Gym
Fuel
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4. Energy Efficiency Measures

Although energy intensity is not particularly high for the most part, there are still considerable opportunities for energy savings within the facilities. The following discussion is based on the site visits and the utility data provided. General opportunities applicable to a number of buildings are given in section 4.1, while other, more specific opportunities are give in section 4.2. More information on the buildings can be found in the appendix.

4.1 General Opportunities

Lighting

Many of the buildings still use fluorescent T12 lighting with magnetic ballasts in some or all areas. These should be upgraded to more efficient T8 lamps with electronic ballasts, which provide improved lighting quality as well as energy savings. Although some incandescent lights have been converted to compact fluorescents, others remain. These should be converted to CFLs wherever possible. Metal halide lighting can be upgraded to pulse start metal halide or converted to fluorescent lighting (which allows easier on/off switching during the day). Other lighting opportunities include occupancy sensors, LED exit lights, and reducing light levels in overlit areas.

Building Controls

Most of the facilities have a computerized building automation system (BAS). There has been steady expansion of the system over the past few years. Continuing to expand these systems will help improve equipment control and efficiency. Over time, BAS controls can be overridden and become less efficient, and a recommissioning of controls is necessary. It may be advisable for the City to have regularly scheduled controls recommissioning by someone well versed in both BAS and energy efficiency.

There are some buildings and systems which are too small or do not have complex enough equipment to justify such a system and are controlled by a zone thermostat. Where schedules are fairly regular, these should be controlled by a programmable thermostat. It is fairly common for programmable thermostats to be overridden or schedules to be changed by occupants, and all programmable thermostats should be checked regularly. Posting instructions on how to adjust temperatures temporarily without permanently overriding can be helpful. It may be useful to standardize on a single programmable thermostat for simplicity. Some features to look for are simple 7 day or 5+2 day programming, battery free operation, easy override, and instructions permanently printed on the thermostat case.

For buildings with sporadic occupancy, a standard thermostat can be more effective than a programmable one if it is easily accessible and occupants turn it down when the building is unoccupied. Posting instructions and marking the setback temperature on the thermostat help remind occupants to turn it down when they leave. Most standard thermostats are bi-metallic, which have a large deadband and can be inaccurate. Newer thermostats are electronic and have more precise temperature control, which can result in energy savings. If a programmable thermostat is used in a building with irregular occupancy, one strategy that can work is to set back the temperatures quite low over night (~15°C) and bring them up to a moderate setback (~18°) during the day. Users can then use the override to bring the temperature up to normal when the building is occupied.

Building Envelope

Unless windows are single glazed or there is little or no insulation, it is rarely cost effective to replace windows or add insulation to buildings due to the high cost of these retrofits. However, if work is being done on the building (e.g. roof replacement) it can be a good opportunity to increase the insulation. When windows need to be replaced, make sure they are replaced with low-e windows with thermally broken frames. It can also make sense to upgrade the building envelope in order to improve occupant comfort.

Older buildings often have leaky building envelopes. All weatherstripping on doors and windows should be checked and replaced where necessary. A comprehensive program of weatherstripping, caulking, and sealing the building envelope can reduce infiltration and heat loss, leading to energy savings.

Boiler Plants
Most boiler plants do not operate as efficiently as they could due to improper staging or an inability to eliminate losses from boilers that are off. This is particularly true for atmospheric boilers, which have significant off-cycle losses up the stack. Where possible, boilers should have a means of isolation so water does not flow through them when they are off. This can be by automatic isolation valves or individual circulation pumps. Where this is too costly or impractical, automatic vent dampers are a less costly alternative. It is necessary to convert pilot light boilers to electronic ignition if vent dampers are used.

Old, inefficient boiler plants can be upgraded to mid- efficiency boilers or potentially to condensing boilers. This can be very costly and is most appropriate where future boiler replacement will be necessary anyway. However, it may be more cost effective or appropriate to connect to LEC instead and this should be considered on a case by case basis.

4.2 Building Specific Opportunities

RCMP
Energy consumption is very low, and the building appears to be performing very well.

30% minimum outside air may be more than is required. Confirm the required ventilation air quantities for each air system and set the outside air minimum accordingly. Outside air minimums can also be reduced at night to reflect lower occupancy. CO2 control could also be used for ventilation control.

The boiler plant is already fairly efficient, but could be considered for connection to LEC as the size of the facility may justify it.

Fire Hall
The basement air handling unit appears to control dampers based on outside air. It is likely this is not being controlled efficiently. If not already, this unit should be out on the DDC system.

According to staff the bay doors are often open with the unit heaters running. The unit heaters should be interlocked with the doors so that heat is not on when the doors are open. The bay doors could also be replaced with insulated doors, although this would likely be a long payback.

There are some single glazed windows in the building. These could be replaced with double glazed low-e argon windows with insulated frames. However, even replacing single glazed windows is usually a very long payback.

City Hall & Library

There is an excessive amount of wall wash lighting being used. Efforts should be made to reduce the wattage in these fixtures or eliminate them.

For the most part, lighting is currently switched in large banks, rather than having individual room switches. Rewiring to allow individual switching, with computer controlled sweeps, would allow rooms to be switched off when not occupied. However, this will be quite costly and it is doubtful the energy savings will pay for it.

Although most of the building is on LEC, there is and inefficient DHW boiler and storage tank in the west wing. This should be converted to LEC and the boiler shut down. This would also allow the gas service to be eliminated, saving the monthly fixes charges as long as no other gas appliances are still needed.

New Library

Although the building is new, there are some operational issues that could potentially improve efficiency and performance. The major issue in the operation of the building is that the ground field is only being used to reject heat during cooling, and not for heat extraction during heating. This is partly the cause of overheating, as ground fields usually need both cooling and heating to maintain reasonable field temperatures. The system is apparently capable of rejecting heat to the ground field, but is not being operated that way due to a perceived requirement to purchase all heat from LEC. The operation of the heat pumps should be investigated further and discussed with LEC to ensure that the most beneficial operating strategy is employed.

The ventilation units are controlled based on CO2, and probably run at low volume at most times. They could also be used as a source of free cooling, by operating them at higher volumes during mild weather. Maximum volume should probably be capped at around 80% to avoid excessive fan energy.

To avoid overheating of the ground field, use the air cooled chillers as the first stage of cooling. It may be necessary to run the parkade exhaust fans if the parkade gets too hot.

There seems to be an excess of lights left on at times when the library is not open, in order for staff to sort books. And the daylighting controls have been overridden to ensure adequate light levels. This should be looked at again to see if there is any way in which staff needs and energy savings objectives can be met, perhaps through the use of occupancy sensors.

City Works Yard

Remove eggcrate louvers and replace with prismatic lens, reducing the number of lamps where overlit. Install occupancy sensors to control equipment shed lights, so they can go off unless needed.

The shop bay radiant heaters should be interlocked with the doors so that heat is not on when the doors are open. The thermostats could be put onto the DDC system and set back

at night. The bay doors could also be replaced with insulated doors, although this would likely be a long payback. The outdoor radiant heaters should be disconnected.

The wash water may be a good candidate for solar water heating if use is consistent throughout the year.

Presentation House
Apparently the attic roof is not insulated. This is one of the few insulation upgrades that can be cost effective. Some concerns were expressed about the ability of the roof to withstand snow loading, which will need to be taken into consideration. Windows are single glazed and could be changed to double glazed low-e argon windows with insulated frames. However, even replacing single glazed windows is usually a very long payback.

Radiators in the theatre lobby have no thermostatic control and run wild (manual control valve). A thermostatic control valve should be installed. There is some bare hot water piping in the corridors which should be insulated.

NS Neighbourhood House
The gym fan should have CO2 sensors installed to vary ventilation rates with occupancy.

Mahon Park Facilities
Walls are uninsulated in these facilities. Even so, it is likely not cost effective to insulate since occupancy is sporadic and temperatures can be turned down much of the time.

There are gas furnaces in the concession and clubhouse. These can be replaced with new high efficiency condensing furnaces.

The temperature in the stadium storage is kept quite high (67°F) and the thermostat is inconveniently located behind stacks of chairs. As a storage room it should be possible to keep the temperature quite low (~8 - 10°C), although any specific temperature requirements related to storage of the historic railcar should be confirmed. The thermostat could be placed in a lockbox to prevent tampering. If higher temperatures are needed to work on the railcar, the thermostat should be relocated near the door and a sign placed beside it to instruct people to turn the temperature down when they leave.

John Braithwaite
Occupancy sensors seem to have a very long delay in some cases (or are faulty?). These should be checked and adjusted. In the exercise room and potentially some other areas, the use of both suspended and recessed fixtures may be excessive. Light levels should be reviewed and only one fixture type used where appropriate.

Both chilled water pumps were running at the time of the site visit, although cooling loads should have been low. These should be staged or operated as lead/lag. Alternatively these may be able to operate on variable speed drives.

The gym fan should have CO2 sensors installed to vary ventilation rates with occupancy.

Electricity consumption is quite high at John Braithwaite and there is likely to be savings from a more in-depth review and recommissioning of controls. It was not possible to look at all systems during the site visit.

Mickey McDougall
The boiler is required to run all year to serve the DHW storage tank. This (large) tank could be replaced with a smaller high efficiency stand-alone hot water tank, allowing the boiler to be shut down in summer and reducing storage losses as well.

The gym fan could use CO2 control of ventilation, as well as a variable speed drive to reduce flow during unoccupied periods based on occupancy sensors or override switch.

Any retrofits of this building will have to take into consideration the proposed Harry Jerome redevelopment plans.

Harry Jerome
The gymnasium has very low light levels, even for amateur gymnastics. These could be converted to pulse start metal halides or changed to fluorescent, but an increase in light levels would likely be part of any retrofit. As such, energy consumption would likely rise.

The boiler plant operates inefficiently because both boilers cycle on when there is call for heating. This can be corrected by adjusting the controls. However, the boiler that is off will continue to lose heat as there is no way of isolating it from the system. Boiler isolation valves could be installed to isolate the boiler when off. Although not quite as effective, a less costly option would be to install automatic flue dampers if there is sufficient space. In the longer term these boilers will need to be replaced. The most efficient option would be to connect the building to the Lonsdale Energy System. Otherwise a new plant with high efficiency condensing boilers should be installed.

Heat should be recovered from the ice plant condenser water. There are several option for its use, including direct use for ice melt or preheat for zamboni water or domestic hot water. Because the condenser water only flows when the compressors are on, a storage tank will be required.

The zamboni water is currently mixed by hand to adjust temperature. A thermostatic mixing valve could be used to maintain a constant temperature. A maximum temperature of 130°F is recommended.

An ice temperature sensor could be installed and used to control the ice plant. This would allow the optimal ice temperature to be set for the type of activity (e.g. hockey -5°C, public skating -3°C, overnight -1°C).

The concrete block wall in the gymnasium could be insulated. However, the addition of insulation is costly and will rarely pay back.

Any retrofits of this building will have to take into consideration the proposed Harry Jerome redevelopment plans.

Centennial Theatre
The controls should be reprogrammed so the air handler is not running when not required. Because the theatre has erratic schedules, override switches located in the production office would be beneficial. Two override switches would allow different setpoints for setup and shows. Concerns have been raised by staff about the ability of the system to bring the building up to temperature quickly enough, but this can be addressed by having a higher unoccupied setpoint in the daytime than at night (e.g. 15°C night, 18° unoccupied day, 20°

setup, 22° show). The air handler would only come on during unoccupied hours if needed to maintain setpoint.

Variable speed drives could be installed on the main air handler to allow it to run at reduced volume during unoccupied or setup periods. The fans would run at minimum flow (perhaps 50%) during those periods, unless higher flows are required for heating or cooling. Demand controlled ventilation could be used to vary outside air quantities, using CO2 sensors.

Memorial Gym

The gym fan could use CO2 control of ventilation, as well as a variable speed drive to reduce flow during unoccupied periods based on occupancy sensors or override switch.

The boiler is new, but is atmospheric and not very efficient. An automatic flue damper should be installed to reduce off-cycle losses.

Any retrofits of this building will have to take into consideration the proposed Harry Jerome redevelopment plans.

Summary of Key Measures

Building	Recommended	Optional
RCMP	Reduce light levels CO2 ventilation control Confirm ventilation req'ts	Connect to LEC
Fire Hall	Lighting retrofit / redesign Insulated bay doors Interlock bay doors with heating Boiler flue dampers	New hi-eff boilers, *or* Connect to LEC
City Hall & Library	Lighting retrofit / redesign Occupancy sensors Connect DHW to LEC	
New library	Review dimming/occupancy ctrls Use ground loop for heating Use ventilation fans for free cooling	
City Works Yard	Lighting retrofit / redesign Weatherstripping/sealing Insulated bay doors Interlock bay doors with heating Disconnect radiant outdoor heaters	Solar wash water heating
Presentation House	Lighting retrofit Weatherstripping/sealing Insulate attic space Thermostatic radiator valve Insulate bare piping Programmable thermostats Boiler flue damper	New hi-eff boiler, *or* Connect to LEC Window replacement
NS Neighbourhood House	Lighting retrofit / redesign CO2 ventilation control Boiler flue dampers	New hi-eff boilers, *or* Connect to LEC
Mahon Park Facilities	Lighting retrofit Weatherstripping/sealing High efficiency furnaces	Insulate walls

	Programmable thermostats Lockbox or relocate stadium t'stat	
John Braithwaite	Lighting redesign Recommission controls CO2 ventilation control	
Mickey McDougall	Lighting retrofit CO2 ventilation control Variable speed drives New stand-alone DHW tank	
Harry Jerome	Lighting retrofit Heat recovery from ice plant Ice temperature controls Boiler isolation/flue dampers	New hi-eff boilers, *or* Connect to LEC
Centennial Theatre	Lighting retrofit CO2 ventilation control Variable speed drives Boiler flue damper	Connect to LEC
Memorial Gym	Lighting retrofit CO2 ventilation control Variable speed drives Boiler flue damper	Connect to LEC

It should be noted that boiler replacements and/or connection to LEC have been listed as optional components. This is because it is not known whether LEC would be willing to connect some of the buildings, while the future of others is uncertain.

5. Potential Energy Savings and Estimated Costs

Potential savings have been estimated based on utility bills and building descriptions, as well as the site visits performed. Savings are based on the recommended measures, without including the optional measures. Capital costs are estimated based on rule-of-thumb unit area and percentage costs. It is particularly difficult to estimate capital costs on small buildings, or where measures may be undertaken in-house by staff. **Both savings and costs should be considered rough estimates, intended to provide guidance prior to further analysis.**

Estimated Energy Savings Potential by Building

Building	Potential savings	
RCMP	2%	$ 2,017
Fire Hall	16%	$ 5,076
City Hall & Library	5%	$ 4,352

New library	12%	$ 6,652
City Works Yard	10%	$ 3,934
Presentation House	17%	$ 3,327
NS Neighbourhood House	13%	$ 2,742
Mahon Park Facilities	17%	$ 2,378
John Braithwaite	14%	$ 8,707
Mickey McDougall	8%	$ 1,082
Harry Jerome	16%	$ 27,502
Centennial Theatre	28%	$ 11,198
Memorial Gym	8%	$ 1,657
Total	12%	$ 80,624

Note: Boiler replacements and/or LEC connection have not been included in the energy savings estimates or capital costs. It would significantly increase the potential savings if these projects were to go ahead.

Potential savings for a comprehensive retrofit of these buildings is estimated at $80,624 annually, or 12%. The project would also save 222 tonnes of GHG emissions, or 15%, which can be valued at $25/tonne based on the cost of offsets committed to through the Climate Action Charter, for additional savings of $5,552 . There may be additional savings from reduced operating and maintenance costs, but these have not been included.

Capital cost for a project of this scope is estimated at $647,703 , including 25% allowance for studies, design engineering, and project management. However, incentives of up to $60,850 may be available from BC Hydro. Additional funding may be available through other sources.

A preliminary financial analysis indicates a simple payback of 6.8 years. Net present value over a 20 year project life would be $591,761 .

Financial Analysis	
Energy savings	$80,624
GHG savings	$5,552
Total savings	$86,175
Capital cost	$518,162
Eng. and project mgmt fees	$129,541
Incentives	($60,850)
Total cost	$586,853
Project term	20 years
Discount rate	6.00%
Inflation	2.00%
Simple payback	6.8 years
Net present value	$591,761

Although the payback on this project is fairly short, City of North Vancouver may want to extend the payback in order to achieve greater savings, include more equipment renewal, or include renewable energy technologies (such as solar water heating) in order to reduce GHG emissions.

6. Recommendations and Next Steps

This opportunity assessment has shown that there is considerable potential for energy savings, in spite of the relatively low energy intensity of many of the facilities. A comprehensive retrofit is financially viable, with an attractive financial return over the life of the project. In addition, a comprehensive energy retrofit provides an opportunity to improve occupant working conditions, replace aging equipment, reduce greenhouse gas emissions, and show leadership on climate change within the community.

If it is necessary to borrow funds in order to implement the recommended measures, it is important to remember that energy efficiency retrofits pay for themselves out of utility savings. Financing costs will be matched by reduced energy bills. This means that there is no impact on overall municipal budgets or on taxpayers.

Many of the measures are repeated in a number of buildings (lighting retrofits, boiler flue dampers, VSDs and CO2 control). These will be more cost effective if all buildings are done at one time.

Some of the measures do not necessarily require further analysis, and can be implemented by staff. These include programmable thermostats, occupancy sensors, and weatherstripping/sealing.

There is potential for considerably greater savings by replacing boilers or connecting to LEC. This will need to take into consideration future plans for the buildings as well as LEC expansion plans.

Recommended next steps:

- Review the life expectancy of the facilities and identify any other projects planned that may overlap with an energy retrofit.
- Determine which facilities can be connected to LEC.
- Have an engineer investigate further savings opportunities at John Braithwaite.
- Determine what work can be done in-house, and how the remaining work will be contracted out.
- Set aside sufficient budget to undertake the work, and determine how it will be financed.
- Confirm requirements for BC Hydro incentives, and investigate any other potential funding opportunities.

Appendix

Utility Summary
Building Reports

City of North Vancouver Utility Data

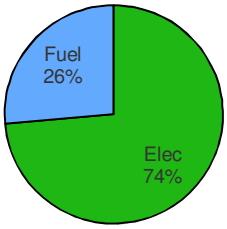
Building name	Area	Energy Consumption				Energy Cost			BEPI (ekWh/ft²)			GHGs (tonnes CO2eq)		
		Elec (kWh)	Elec (GJ)	Fuel (GJ)	Total (GJ)	Elec	Fuel	Total	Elec	Fuel	Total	Elec	Fuel	Total
RCMP	116,057	1,524,240	5,487	3,268	8,754	$ 91,454	$ 32,676	$ 124,130	13.1	7.8	21.0	33.5	166.6	200.2
Fire Hall	20,003	337,680	1,216	1,212	2,428	$ 20,261	$ 12,124	$ 32,385	16.9	16.8	33.7	7.4	61.8	69.3
City Hall & Library	42,437	912,600	3,285	1,788	5,073	$ 54,756	$ 32,279	$ 87,035	21.5	11.7	33.2	20.1	101.7	121.7
New library	36,423	674,880	2,430	854	3,284	$ 40,493	$ 15,425	$ 55,917	18.5	6.5	25.0	14.8	48.6	63.4
City Works Yard	18,098	306,320	1,103	2,096	3,199	$ 18,379	$ 20,964	$ 39,343	16.9	32.2	49.1	6.7	106.9	113.7
Presentation House	15,602	153,440	552	1,003	1,555	$ 9,206	$ 10,030	$ 19,236	9.8	17.9	27.7	3.4	51.2	54.5
NS Neighbourhood Hou	19,600	164,100	591	1,106	1,697	$ 9,846	$ 11,060	$ 20,906	8.4	15.7	24.0	3.6	56.4	60.0
Mahon Park Facilities	6,865	108,080	389	790	1,179	$ 6,485	$ 7,900	$ 14,385	15.7	32.0	47.7	2.4	40.3	42.7
John Braithwaite	34,755	641,250	2,308	1,222	3,530	$ 38,475	$ 21,661	$ 60,136	18.5	9.8	28.2	14.1	69.2	83.3
Mickey McDougall	22,467	97,080	349	834	1,183	$ 5,825	$ 8,340	$ 14,165	4.3	10.3	14.6	2.1	42.5	44.7
Harry Jerome	90,018	1,597,380	5,751	7,167	12,917	$ 95,843	$ 71,670	$ 167,513	17.7	22.1	39.9	35.1	365.5	400.7
Centennial Theatre	29,095	319,620	1,151	2,099	3,250	$ 19,177	$ 20,990	$ 40,167	11.0	20.0	31.0	7.0	107.0	114.1
Memorial Gym	20,691	133,800	482	1,316	1,798	$ 8,028	$ 13,160	$ 21,188	6.5	17.7	24.1	2.9	67.1	70.1
Total	**472,112**	**6,970,470**	**25,094**	**24,755**	**49,847**	**$ 418,228**	**$ 278,278**	**$ 696,506**				**153**	**1,285**	**1,438**

Building: **RCMP**
Area: 116,057 ft²

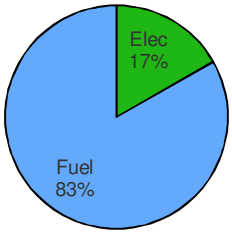
Consumption Data

Elec	1,524,240	kWh	$ 91,454	33.5	tonnes CO2e
Fuel	3,268	GJ	$ 32,676	166.6	tonnes CO2e
Total	8,754	GJ	$ 124,130	200.2	tonnes CO2e

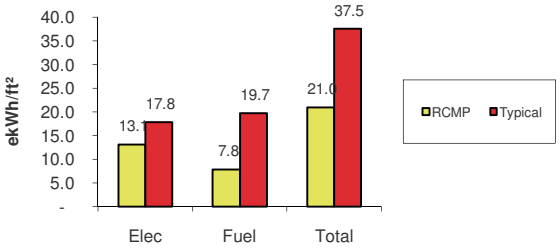
	RCMP		*Typical*	
Elec	13.1	ekWh/ft	17.8	ekWh/ft
Fuel	7.8	ekWh/ft	19.7	ekWh/ft
Total	21.0	ekWh/ft	37.5	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - RCMP vs Typical

Building description

The RCMP is a three storey building built in 1988. It is in good condition with relatively new and efficient systems. Energy consumption is quite low for a building of this type, in spite of the 24 hour operation.

Hours of use: 24/7

Lighting

Lighting is predominantly linear fluorescent, with T8 lamps and electronic ballasts. There are also a number of compact fluorescents, using 2x26PL. In the atrium there are metal halide fixtures, but these are generally not used. Light levels seem appropriate in most areas, although some corridors and stairwells are overlit.

HVAC

The building is served by five VAV reheat systems with variable speed drives. Systems run 24 hrs/day, but individual boxes have night temperature setback and box minimums at zero. Outside air minimum is 30%, with economizer control. Heating is provided by two 2000 MBH forced draft boilers, which are shut down in summer. Chilled water is provided by a water cooled chiller with an open cooling tower. DHW is from stand-alone tanks with a large storage tank.

Potential Measures

Lighting Strategies

* Reduce number of lamps and/or fixtures if over designed.

Other

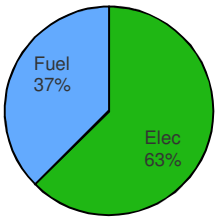
* Confirm ventilation req'ts
* Connect to LEC

Building: **Fire Hall**
Area: 20,003 ft²

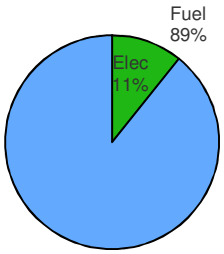
Consumption Data

Elec	337,680	kWh	$ 20,261	7.4	tonnes CO2e
Fuel	1,212	GJ	$ 12,124	61.8	tonnes CO2e
Total	2,428	GJ	$ 32,385	69.3	tonnes CO2e

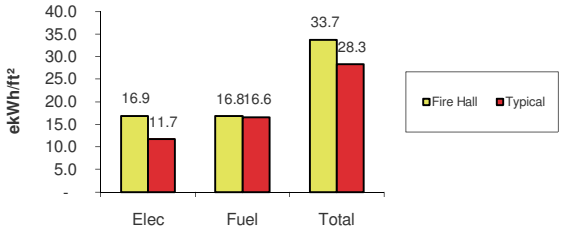
	Fire Hall		*Typical*	
Elec	16.9	ekWh/ft	11.7	ekWh/ft
Fuel	16.8	ekWh/ft	16.6	ekWh/ft
Total	33.7	ekWh/ft	28.3	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - Fire Hall vs Typical

Building description

The firehall is a concrete building built in the 1980's. It has single glazed windows in metal frames. The bay doors are uninsulated.

Hours of use: 24/7

Lighting

Lighting is generally linear fluorescent, with T8 lamps and electronic ballasts, with CFLs in some areas. A few T12 and incandescent lamps remain. While light levels are appropriate in some areas, there are quite a few areas where light levels are excessively high. Quite a number of rooms had lights left on while unoccupied.

HVAC

The administration and other areas are served by seven heat pump rooftop units, and one gas-fired air handling unit in the basement. The truck bay and repair bay have hot water unit heaters, served by two 500 MBH atmospheric boilers. The boilers have pilot lights and no method of isolation when off. There is a stand-alone gas DHW tank.

Potential Measures

Lighting Strategies

* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Reduce number of lamps and/or fixtures if over designed.
* Install compact fluorescent lamps to replace incandescent.
* Install occupant sensor controls to turn off lights when not required.

HVAC Energy Cost Savings Strategies

* Install higher efficiency or condensing gas boilers
* Install automatic flue dampers, isolation valves, or circulation pumps and incorporate boiler staging to minimize losses.
* Recommission controls to improve operation and introduce control strategies to schedule equipment, reset supply air and water temperatures, and optimally start and stop equipment.

Other

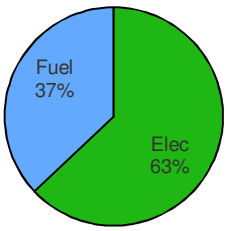
* Install insulated bay doors
* Interlock bay doors with heating
* Connect to LEC

Building: **City Hall & Library**
Area: 42,437 ft²

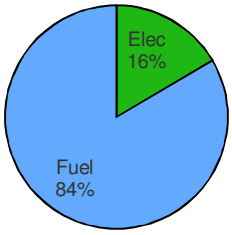
Consumption Data

Elec	912,600	kWh	$ 54,756	20.1	tonnes CO2e
Fuel	1,788	GJ	$ 32,279	101.7	tonnes CO2e
Total	5,073	GJ	$ 87,035	121.7	tonnes CO2e

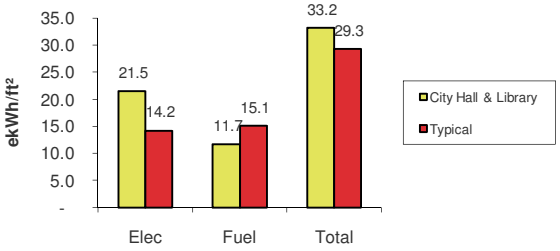
	City Hall & Library		*Typical*	
Elec	21.5	ekWh/ft	14.2	ekWh/ft
Fuel	11.7	ekWh/ft	15.1	ekWh/ft
Total	33.2	ekWh/ft	29.3	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - City Hall & Library vs Typical

Building description

The civic centre building houses City hall and the old library, which is now closed and being renovated.Construction is concrete and steel frame, with double glazed windows in metal frames. Energy consumption is fairly typical, but this is distorted by the vacant library space. Fuel consumption has dropped significantly since the conversion to LEC, but electricity consumption is still high.

Hours of use: M-F 8am - 5pm, plus council meetings Mon to 10pm

Lighting

The building lighting has largely been converted to T8 lamps with electronic ballasts and compact fluorescents (CFLs). There are still a few incandescent lamps, noticeably in the council chambers and through the use of low voltage halogen downlights in various areas. Most areas have reasonable light levels, but corridors are somewhat overlit, as well as an excess of wall wash fixtures. Lighting is controlled by large lighting banks, with little individual room control. There are a few occupancy sensors.

HVAC

The HVAC system is VAV reheat, with two rooftop units and one interior air handling unit. All fans are on variable speed drives (VSD). There is insufficient flow to the council chambers, and boxes are controlled by occupancy sensor to shift flow to the council chambers when in use. Heating pumps are on a VSD with box valves converted to 2-way. Chilled water and condenser water pumps are constant volume. Heating is provided by LEC, with a small boiler and storage tank for DHW in the west wing. Cooling is by a central water cooled chiller.

Potential Measures

Lighting Strategies

* Reduce number of lamps and/or fixtures if over designed.
* Install compact fluorescent lamps to replace incandescent.
* Install occupant sensor controls to turn off lights when not required.

Other

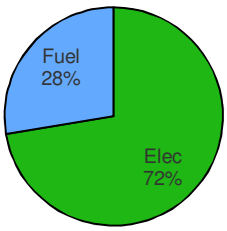
* Connect DHW system to LEC

Building: **New library**
Area: 36,423 ft²

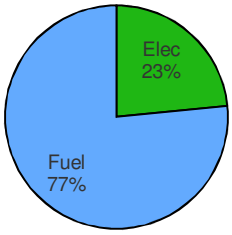
Consumption Data

Elec	674,880	kWh	$ 40,493	14.8	tonnes CO2e
Fuel	854	GJ	$ 15,425	48.6	tonnes CO2e
Total	3,284	GJ	$ 55,917	63.4	tonnes CO2e

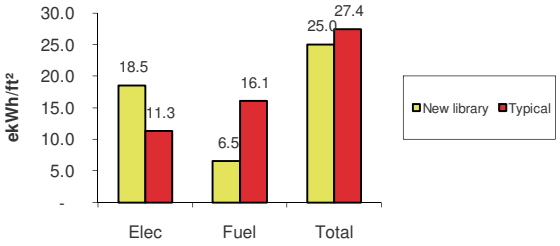
	New library		*Typical*	
Elec	18.5	ekWh/ft	11.3	ekWh/ft
Fuel	6.5	ekWh/ft	16.1	ekWh/ft
Total	25.0	ekWh/ft	27.4	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - New library vs Typical

Building description

The new library was built in 2008 to LEED standards. It is concrete and curtainwall construction, with low-e argon filled windows. Energy consumption is fairly typical for a facility of this type.

Hours of use: M-F 9am - 9pm, Sat 9am - 5pm, Sun 1pm - 5pm

Lighting

Lighting is predominantly T8 lamps and CFLs. There are daylight dimming controls installed, but there have been problems getting this to work effectively and they are currently turned off. Lights appear to run longer hours than necessary, with all lights switched on early in the morning.

HVAC

Heating and cooling is provided by hot and chilled water coils in the building slab. Water to water heat pumps provide chilled water and hot water, while two air cooled chillers in the parkade provide additional chilled water. Heat rejection in cooling mode is provided by a ground field loop and a small fountain. Heat extraction in heating mode is made up by heat from LEC. In the first year there have been some problems with overheating as the ground field has not been capable of dissipating all the heat. There are ventilation units to provide fresh air, with variable speed drives and CO2 control.

Potential Measures

Lighting Strategies

* Install occupant sensor controls to turn off lights when not required.
* Install daylight dimming systems to reduce lighting energy use when daylighting permits it.

Other

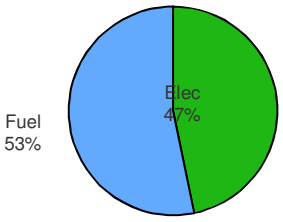
* Use heat pumps for heating with extraction from ground loop
* Use ventilation fans for free cooling

Building: **City Works Yard**
Area: 18,098 ft²

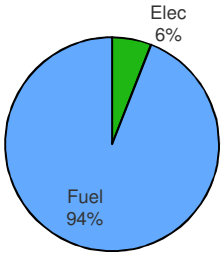
Consumption Data

Elec	306,320	kWh	$ 18,379	6.7	tonnes CO2e
Fuel	2,096	GJ	$ 20,964	106.9	tonnes CO2e
Total	3,199	GJ	$ 39,343	113.7	tonnes CO2e

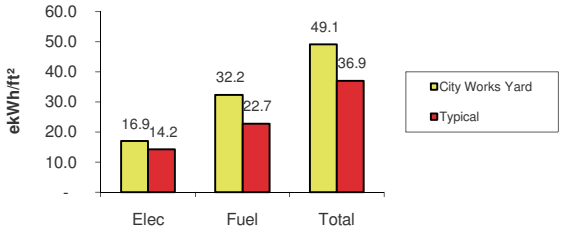
	City Works Yard		*Typical*	
Elec	16.9	ekWh/ft	14.2	ekWh/ft
Fuel	32.2	ekWh/ft	22.7	ekWh/ft
Total	49.1	ekWh/ft	36.9	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - City Works Yard vs Typical

Building description

The Public Works yard consists of a number of buildings, mostly concrete block with no external insulation. Bay doors are not insulated. Energy consumption is somewhat higher than typical for this type of facility, particularly in natural gas, but should be expected to drop now that a new boiler plant has been installed.

There is some question as to the future of this facility.

Hours of use: M-F 7am - 5pm

Lighting
Lighting is generally linear fluorescent, with T8 lamps and electronic ballasts. A few T12 and incandescent lamps remain. Light levels are appropriate in some areas and significantly overlit in others. Eggcrate louvers are used in some areas. A number of rooms had lights left on while unoccupied. Lights in the outdoor equipment sheds are left on all night in case of callouts.

HVAC
A new boiler plant has been installed with high efficiency condensing boilers. Two gas rooftop units serve the office areas. The shop bays have gas radiant heaters, controlled by manual thermostats set between 10°C and 14°C. The wash house has a gas unit heater, as well as a 500 MBH instantaneous wash water heater. There are also some gas radiant heaters outdoors.

Potential Measures

Lighting Strategies
* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Reduce number of lamps and/or fixtures if over designed.
* Install compact fluorescent lamps to replace incandescent.
* Install occupant sensor controls to turn off lights when not required.

Building Envelope
* Install weather stripping, caulk around windows and doorways, check seals

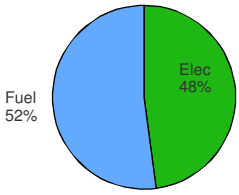
Other
* Interlock bay doors with heating
* Install insulated bay doors
* Disconnect radiant outdoor heaters

Building: **Presentation House**
Area: 15,602 ft²

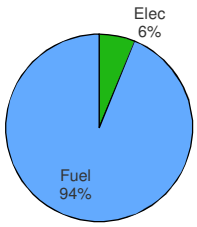
Consumption Data

Elec	153,440	kWh	$ 9,206	3.4 tonnes CO2e
Fuel	1,003	GJ	$ 10,030	51.2 tonnes CO2e
Total	1,555	GJ	$ 19,236	54.5 tonnes CO2e

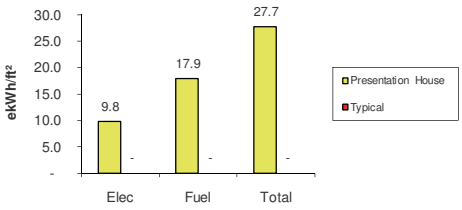
	Presentation House		*Typical*	
Elec	9.8	ekWh/ft	-	ekWh/ft
Fuel	17.9	ekWh/ft	-	ekWh/ft
Total	27.7	ekWh/ft	-	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - Presentation House vs Typical

Building description

Presnetation House is a wood post and beam building built in 1902. It has had various additions and renovations since then. Windows are single glazed. Apparently there is no attic insulation, although this was not observed on site. While electricity consumption is reasonable, gas consumption is somewhat high, although there are no direct comparable figures given the mixed usage of the building.

Hours of use: 8am - 11pm Tu - Sat, 8am - 5pm Mon, noon - 5pm Sun. Use varies throughout the building.

Lighting

There is a wide mix of lighting. The lower floor has T8 and T12 fluorescent, as well as track lighting with incandescent lamps and low voltage halogen. There are also potlights with CFLs. The musuem is almost exclusively track incandescent. The theatre stage has eight 90W incandescent flood lamps that are on at all times plus 300 W halogen lamps used for stage setup, as well as specialized stage lighting used for performances. A significant amount of lighting seems to be left on for security/emergency purposes.

Exit lights are incandescent, and exterior lighting is both HPS and incandescent, with timer control although some lights were observed on during the day.

HVAC

The building has an old atmospheric boiler with pilot light. This was originally two stage, but only one stage fires now.There is one small heating pump with no zoning. Heating throughout the building is mostly by hot water unit heaters with some hot water radiation. There is also some electric baseboard. Thermostats are standard (although the radiation has no thermostat, just a manual valve) and in some cases line voltage. Some hot water piping is uninsulated and provides heat to the corridor.

There are two air handling units, one for the theatre and one for the museum. The theatre AHU has hot water heat and mixed air dampers that can be manually adjusted and are set to 20-30% to avoid tripping the freeze stat. The museum AHU has hot water heat and DX cooling. It has a minimum fresh air duct with an automatic damper which is kept permanently closed.

DHW is provided by a gas hot water tank.

There is a DDC system installed that controls the boiler, pump, and air handling units as well as space sensors (but not unitary equipment thermostats).

Potential Measures

Lighting Strategies

* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Install compact fluorescent lamps to replace incandescent.
* Use automatic time-clock and/or photocell controls for all exterior lighting not intended for 24 hour use.
* Replace incandescent emergency exit lamps with LED technology.

HVAC Energy Cost Savings Strategies

* Install higher efficiency or condensing gas boilers
* Install automatic flue dampers, isolation valves, or circulation pumps and incorporate boiler staging to minimize losses.
* Install programmable thermostats or timeclocks

Building Envelope

* Install weather stripping, caulk around windows and doorways, check seals
* Install high efficiency double glazed low-e windows
* Install additional insulation in walls and/or roof

Other

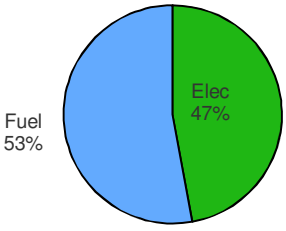
* Connect to LEC
* Install a thermostatic valve on radiators
* Insulate bare hot water piping

Building: **NS Neighbourhood House**
Area: 19,600 ft²

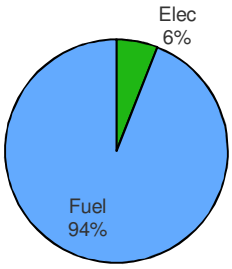
Consumption Data

Elec	164,100	kWh	$ 9,846	3.6	tonnes CO2e
Fuel	1,106	GJ	$ 11,060	56.4	tonnes CO2e
Total	1,697	GJ	$ 20,906	60.0	tonnes CO2e

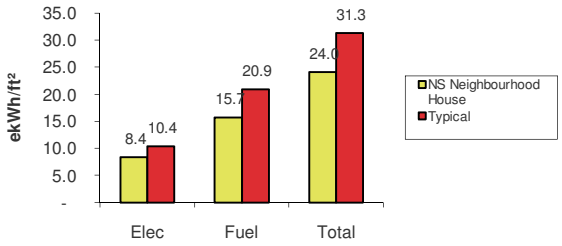
	NS Neighbourhood House		*Typical*	
Elec	8.4	ekWh/ft	10.4	ekWh/ft
Fuel	15.7	ekWh/ft	20.9	ekWh/ft
Total	24.0	ekWh/ft	31.3	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - NS Neighbourhood House vs Typical

Building description

North Shore Neighbourhood House is a concrete block building built in 1966 with various additions and renovations since then. Windows are double glazed in metal frames. The building contains a gymnasium and various community rooms, with a significant amount of office area. Energy consumption is somewhat lower than typical for this type of facility.

Hours of use: 9am - 8pm WD, 9am - noon Sat. Room rentals at other times.

Lighting
Lighting is T12 fluorescent with magnetic ballasts, with some T8 electronic. Light levels are generally good to perhaps a bit low, although some basement corridors appear overlit. Exit lights are incandescent.

HVAC
Two small atmospheric boilers provide hot water to perimeter radiation, on standard thermostats. These have no vent dampers or means of isolation. There is one boiler circulation pump and 4 heating zone pumps.

There are three gas rooftop units serving various areas. There is a gas makeup air unit for the gymnasium with split DX cooling.

DHW is provided by a gas hot water tank.

DDC control has recently been added to the building, controlling the boilers, pumps, rooftop units, with space sensors.

Potential Measures

Lighting Strategies
* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Reduce number of lamps and/or fixtures if over designed.

HVAC Energy Cost Savings Strategies
* Install higher efficiency or condensing gas boilers
* Install automatic flue dampers, isolation valves, or circulation pumps and incorporate boiler staging to minimize losses.
* Install CO2 sensors to vary ventilation rates during low occupancy periods.

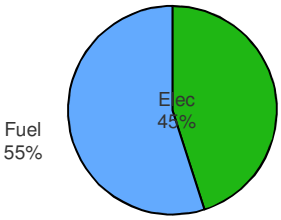
Other
* Connect to LEC

Building: **Mahon Park Facilities**
Area: 6,865 ft²

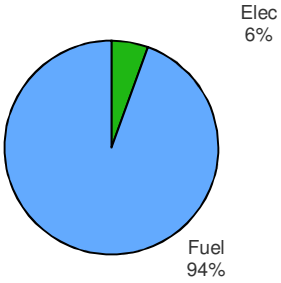
Consumption Data

Elec	108,080	kWh	$ 6,485	2.4	tonnes CO2e
Fuel	790	GJ	$ 7,900	40.3	tonnes CO2e
Total	1,179	GJ	$ 14,385	42.7	tonnes CO2e

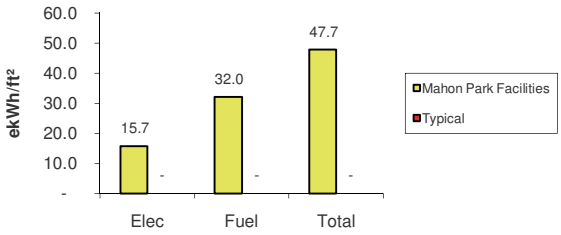
	Mahon Park Facilities		*Typical*	
Elec	15.7	ekWh/ft	-	ekWh/ft
Fuel	32.0	ekWh/ft	-	ekWh/ft
Total	47.7	ekWh/ft	-	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - Mahon Park Facilities vs Typical

Building description

Mahon Park consists of three buildings - stadium with storage underneath, concession and dressing rooms, and club building. There is also stadium field lighting. The stadium storage is used to store an antique rail car that is being restored. The stadium and concession buildings are concrete block with no external insulation. The clubhouse is wood frame with some solid wood walls. Gas consumption is quite high, although there are no direct comparables. Consumption is highest in the clubhouse, although it has dropped significantly from 2008 to 2009.

Hours of use: Irregular, by event. Mostly summer use.

Lighting
Most lighting is T12 fluorescent with some T8 lamps and some incandescent.

HVAC
The stadium storage has gas radiant heaters on standard thermostats, set to 67°F. One heater does not work. There are also electric baseboard heaters on standard thermostats, which are not working.

The concession washrooms and dressing rooms have small gas furnaces on programmable thermostats. The concession is heated by electric radiant heaters on a manual switch. There is a large DHW tank for the dressing room and concession and a small one for the WC. The concession has a small gas stove.

The clubhouse a gas furnace controlled by a standard thermostat, with a sign to turn down to 13° upon leaving. There are also electric baseboards with an old programmable thermostat, set to 10° at all times. There is a small gas stove.

Potential Measures

Lighting Strategies
* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Install compact fluorescent lamps to replace incandescent.

HVAC Energy Cost Savings Strategies
* Install high efficiency furnaces.
* Install programmable thermostats or timeclocks

Building Envelope
* Install weather stripping, caulk around windows and doorways, check seals
* Install additional insulation in walls and/or roof

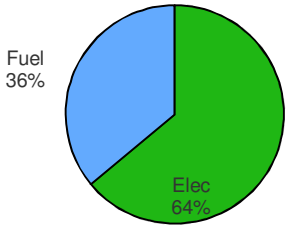
Other
* Reduce setpoint for stadium storage and place thermostat in lock box.

Building: **John Braithwaite**
Area: 34,755 ft²

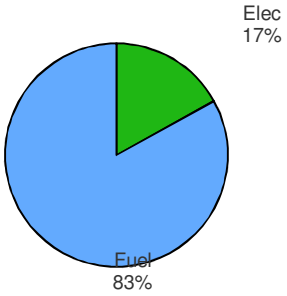
Consumption Data

Elec	641,250	kWh	$ 38,475	14.1	tonnes CO2e
Fuel	1,222	GJ	$ 21,661	69.2	tonnes CO2e
Total	3,530	GJ	$ 60,136	83.3	tonnes CO2e

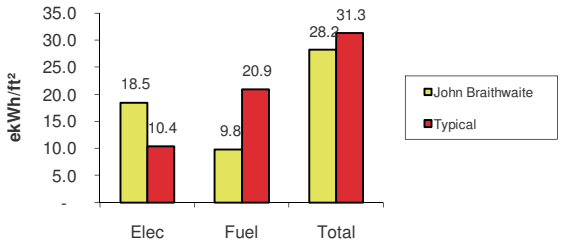
	John Braithwaite		*Typical*	
Elec	18.5	ekWh/ft	10.4	ekWh/ft
Fuel	9.8	ekWh/ft	20.9	ekWh/ft
Total	28.2	ekWh/ft	31.3	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - John Braithwaite vs Typical

Building description

John Braithwaite Centre is a community centre located within a high-reise multi-family building. There is a fitness centre, gymnasium, and various other community spaces. It was built in 2004, with concrete and curtainwall construction. Energy consumption is fairly typical, althouigh it is high in electricity use and low in fuel (district energy) use.

Hours of use: 6am - 10pm M-Th, slightly shorter hours F-Su.

Lighting

Lighting is a mix of linear fluorescent, suspended fixtures, and potlifghts. Originally the suspended fixtures were incandescent but these have been converted to CFLs. Linear fluorescent is all T8 with electronic ballasts, including the gym. Larger rooms have motion sensors.

There are a lot of lights, and in some places both linear fluorescent and suspended fixtures together. Although light levels are generally not excessive, there may be some potential areas where lighting could be reduced.

HVAC

Heating is provided by LEC, with four HW pumps. Cooling is provided by an air cooled chiller located in the parkade. The location gets little air circiulation and two exhaust fans have been added. The chiller runs year round, as well as two 5 HP CHW pumps.

Space conditioning is by fan coil units with HW and CHW coils. There is an air handling unit to provide ventilation to the fan coils (not seen on site), and a constant volume mixed air handling unit for the gym system.

There are two large storage tanks for DHW, heated by LEC, as well as a small electric tank. Some natural gas is used for a fireplace and kitchen appliances.

All systems are controlled by a Delta building automation system.

Potential Measures

Lighting Strategies

* Reduce number of lamps and/or fixtures if over designed.

HVAC Energy Cost Savings Strategies

* Recommission controls to improve operation and introduce control strategies to schedule equipment, reset supply air and water temperatures, and optimally start and stop equipment.

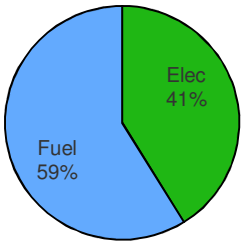
* Install CO2 sensors to vary ventilation rates during low occupancy periods.

Building: **Mickey McDougall**
Area: 22,467 ft²

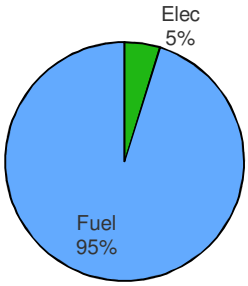
Consumption Data

Elec	97,080 kWh	$ 5,825	2.1	tonnes CO2e
Fuel	834 GJ	$ 8,340	42.5	tonnes CO2e
Total	1,183 GJ	$ 14,165	44.7	tonnes CO2e

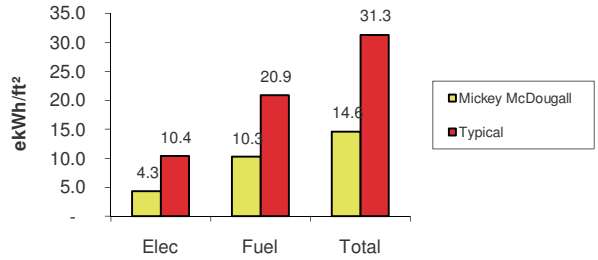
	Mickey McDougall	*Typical*
Elec	4.3 ekWh/ft	10.4 ekWh/ft
Fuel	10.3 ekWh/ft	20.9 ekWh/ft
Total	14.6 ekWh/ft	31.3 ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - Mickey McDougall vs Typical

Building description

This community centre was originally a school until converted in the 1960's. It has concrete block walls with single glazed windows in wood frames, although some have been replaced with double pane low-e. Energy consumption is very low.

Hours of use: 7am - 10pm, 7 days a week.

Lighting
Most lighting has been converted to T8 lamps with electronic ballasts and CFLs. A few T12 lamps and incandescents remain. Lighting in the gym has recently been switched to T5. Dimmable CFLs are used in the activity room. Light levels appear reasonable.

HVAC
Heating is provided by a 1250 MBH water tube forced draft boiler. This runs all year due to DHW requirements. Heating is provided by perimeter radiation. There is a constant volume mixed air system for the gym, with HW heat and DX cooling.

There is a large DHW storage tank fed by the boiler.

Controls are DDC with pneumatic actuation.

Potential Measures

Lighting Strategies
* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Install compact fluorescent lamps to replace incandescent.

HVAC Energy Cost Savings Strategies
* Install variable frequency drives on variable flow air systems
* Install CO2 sensors to vary ventilation rates during low occupancy periods.

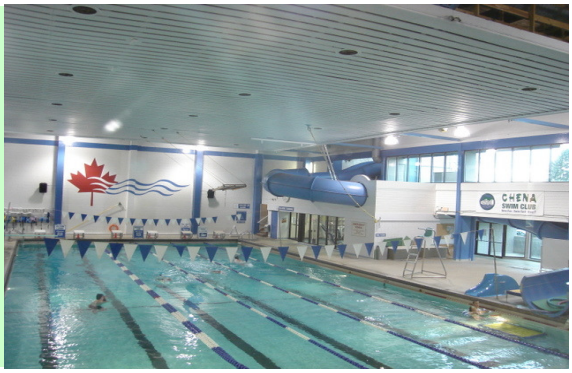
Other
* Install new DHW tank so boiler can shut down in summer.

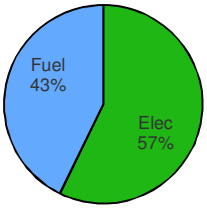
Building: **Harry Jerome**
Area: 90,018 ft²

Consumption Data

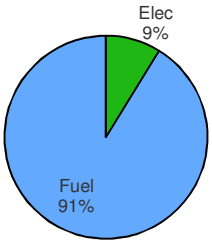
Elec	1,597,380	kWh	$ 95,843	35.1	tonnes CO2e
Fuel	7,167	GJ	$ 71,670	365.5	tonnes CO2e
Total	12,917	GJ	$ 167,513	400.7	tonnes CO2e

	Harry Jerome		*Typical*	
Elec	17.7	ekWh/ft	29.1	ekWh/ft
Fuel	22.1	ekWh/ft	37.3	ekWh/ft
Total	39.9	ekWh/ft	66.4	ekWh/ft

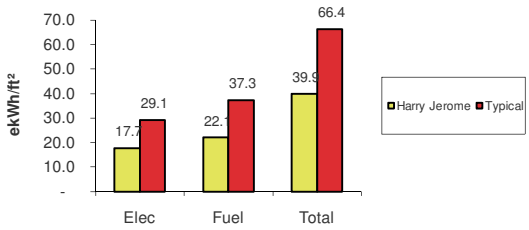




Annual Energy Cost



GHG Emissions



Energy per ft² - Harry Jerome vs Typical

Building description

Harry Jerome is the largest building owned by the City and includes an ice rink, swimming pool, and gymnasium. It was built in 1965. The facility operates from. Construction is a mix of wood frame and concrete block. The gymnasium was originally a curling rink, and the concrete block walls likely have little or no insulation. Windows are double glazed with non-thermally broken aluminum frames. Although Harry Jerome is the largest energy consumer in the City's portfolio, it has quite low energy consumption for a facility of this type.

Hours of use: 5am to 10 pm M-F, with slightly shorter hours on weekends

Lighting
General lighting is fluorescent, with almost all fixtures converted to T8 lamps and electronic ballasts. A few T12 lamps and magnetic ballasts remain, mostly in areas with minimal usage. Most incandescent lamps have been converted to compact fluorescents (CFLs), although some remain. Light levels are generally reasonable. The pool area has metal halide (MH) lamps, with two circuits that are switched by staff according to needs. Light levels are excessive with both circuits on, but only one is used at most times. The ice arena has new MH lighting, thought to be pulse start, with fluorescent lights over the stands. The gymnasium has MH lamps and very low light levels.

HVAC
HVAC is provided by a mix of systems. The pool has a dedicated air handling unit with hot water heat. A mechanical dehumidification system has been installed, with heat recovered for heating of the air. Pool air is maintained at 80°F and 55-60% RH. Pool water is maintained at 82°F. The gymnasium is heated by gas radiant heaters on a programmable t'stat. There are several other air handlers and rooftop units serving other parts of the facility. Heat is provide by two older 2100 MBH atmospheric gas boilers . The boilers run on their own controls and there is no isolation. Both boilers were running at the time of the site visit. A building automation system (BAS) controls most HVAC equipment.

The ice plant has two 75 HP ammonia compressors, cooled by city water. There is a 25 HP brine pump, with a 7.5 HP pony motor. There is no heat recovery, or ice temperature or thickness monitoring. A low-e ceiling has been installed, as well as a desiccant wheel dehumidification system. There is some gas radiant heating over a small section of the stands. A new electric zamboni has been purchased, with resurfacing water mixed from the domestic hot water system. Ice melt is currently outdoors, and is washed down with hot water, but a new ice pit is being constructed indoors.

Potential Measures

Lighting Strategies
* Install compact fluorescent lamps to replace incandescent.
* Use pulse start metal halides, or fluorescent high bay lighting.

HVAC Energy Cost Savings Strategies
* Install higher efficiency or condensing gas boilers
* Install automatic flue dampers, isolation valves, or circulation pumps and incorporate boiler staging to minimize losses.

Building Envelope
* Install additional insulation in walls and/or roof

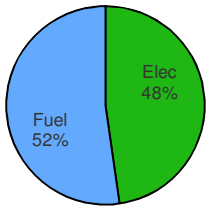
Other
* Connect to LEC
* Heat recovery from ice plant
* Ice temperature controls

Building: **Centennial Theatre**
Area: 29,095 ft²

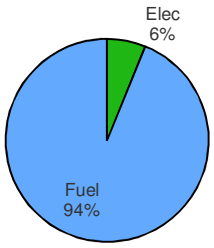
Consumption Data

Elec	319,620	kWh	$ 19,177	7.0	tonnes CO2e
Fuel	2,099	GJ	$ 20,990	107.0	tonnes CO2e
Total	3,250	GJ	$ 40,167	114.1	tonnes CO2e

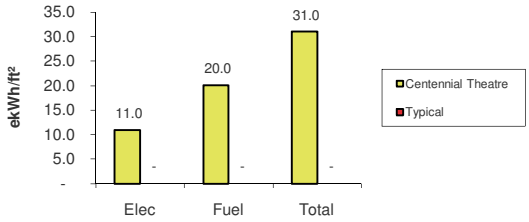
	Centennial Theatre		*Typical*	
Elec	11.0	ekWh/ft	-	ekWh/ft
Fuel	20.0	ekWh/ft	-	ekWh/ft
Total	31.0	ekWh/ft	-	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - Centennial Theatre vs Typical

Building description

Centennial Theatre was built in 1967. A very quick walkthrough was done, looking primarily at lighting and the main HVAC system. Although not a large building, energy consumption is somewhat high in Centennial Theatre, particularly in gas.

Hours of use:

Lighting
There is a mix of incandescent, compact fluorescent, and fluorescent lighting. Some incandecescents have been changed to CFLs, while others remain. At the back of the stage, lighting is provided by 300W incandescent lamps. Lighting in the seating area is incandescent in order to allow dimming and appropriate theatre ambience. Fluorescent lighting is primarily T12 with magnetic ballasts. Specialty incandescent stage lighting is used.

HVAC
A constant volume air handler serves the main theatre. It is a mixed air unit with hot water heating and DX cooling. The unit is controlled by a building automation system, but no on-site computer is available. The unit was running at the time of the site visit, although no production was occurring and both heating and cooling were off. There are several rooftop units that serve ancillary areas of the theatre.

Heating is provided by an older 1200 MBH atmospheric boiler. This appears to run year round, although the temperature is set down in summer.

Potential Measures

Lighting Strategies
* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Install compact fluorescent lamps to replace incandescent.

HVAC Energy Cost Savings Strategies
* Install automatic flue dampers, isolation valves, or circulation pumps and incorporate boiler staging to minimize losses.
* Recommission controls to improve operation and introduce control strategies to schedule equipment, reset supply air and water temperatures, and optimally start and stop equipment.
* Install variable frequency drives on variable flow air systems
* Install CO2 sensors to vary ventilation rates during low occupancy periods.

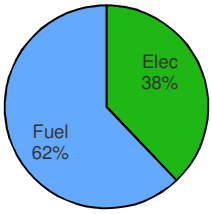
Other
* Connect to LEC

Building: **Memorial Gym**
Area: 20,691 ft²

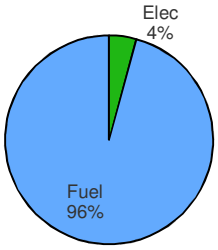
Consumption Data

Elec	133,800	kWh	$ 8,028	2.9	tonnes CO2e
Fuel	1,316	GJ	$ 13,160	67.1	tonnes CO2e
Total	1,798	GJ	$ 21,188	70.1	tonnes CO2e

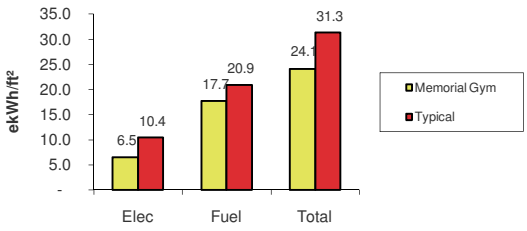
	Memorial Gym		*Typical*	
Elec	6.5	ekWh/ft	10.4	ekWh/ft
Fuel	17.7	ekWh/ft	20.9	ekWh/ft
Total	24.1	ekWh/ft	31.3	ekWh/ft



Annual Energy Cost



GHG Emissions



Energy per ft² - Memorial Gym vs Typical

Building description

Memorial gym was built in 1949, originally as a school. Walls are a mix of concrete block and wood frame, with a mix of single glazed and double glazed windows. Elecrtricty consumption is quite low while gas consumption is slightly lower than typical.

Hours of use: 7am - 10pm, 7 days

Lighting
Most lighting is T8 electronic, although some T12 remains. Most incandescent has been converted to CFLs. Lighting in the gym has recently been switched to T5. Light levels appear reasonable.

HVAC
A single atmospheric boiler serves the building, which was replaced in late 2008. The boiler seerves radiators and fan coils, with some in-floor heating that has failed and been turned off. There is a constaant volume air handler for the gym, and two gas fired units for the excercise room. DX cooling is provided for the excercise room and multi-purpose room. Thermostats are programmable.

There is a new DHW tank with automatic vent damper.

Potential Measures

Lighting Strategies
* Install T8 fluorescent lamps.
* Replace magnetic ballasts with electronic ballasts.
* Install compact fluorescent lamps to replace incandescent.

HVAC Energy Cost Savings Strategies
* Install automatic flue dampers, isolation valves, or circulation pumps and incorporate boiler staging to minimize losses.
* Install variable frequency drives on variable flow air systems
* Install CO2 sensors to vary ventilation rates during low occupancy periods.

Other
* Connect to LEC.

Harry Jerome Recreation Complex

Energy & Emissions Overview

The Harry Jerome (HJ) complex (including Memorial Gym and Mickey McDougall Community Centre) is the largest contributor to the City of North Vancouver's emissions, accounting for 21% of 2009 emissions. Any redevelopment of this site is likely to have a significant impact on the City's emissions profile.

Impact of Lonsdale Energy Corporation.

A redeveloped Harry Jerome will be connected to LEC for district heat. The City must account for emissions used in the generation of heat purchased from LEC. While LEC is an efficient operation, it uses natural gas for the majority of its heat generation. LEC continues to add renewable energy to its portfolio, which contributes to the emissions factor over time.

Harry Jerome could significantly lower emissions by using an efficient form of electric heating such as a heat pump, or renewable energy such as solar hot water or biomass/gasification. LEC will own and operate the HJ heating plant to ensure that waste heat is distributed into the community and emissions reduction would either attributed to the City or spread amongst all LEC customers.

Net Zero Buildings

There is considerable interest in the potential for constructing net zero (NZ) or near net zero (NNZ) buildings. There are many definitions of net zero, but generally the term is premised on producing and selling excess energy at certain times in order to offset energy purchased from the utility at other times. While energy use can become net zero in this way, eliminating emissions is more complicated. BC Hydro requires customers selling power under the Standing Offer to relinquish any carbon credits. It is likely that other utilities such as LEC would do the same. Therefore, while the building itself may generate no net emissions, emissions from purchased energy would still have to be included when calculating the City's emissions profile.

Redevelopment Options

There are many possibilities for energy conservation within a redeveloped HJ. The following options are only intended to show how different designs and system choices might impact the City's emissions profile, and not to be accurate estimates of future consumption or savings potential. A redevelopment floor area of 100,000 ft² has been assumed. It is anticipated that with all redevelopment or renovation options that the heating and cooling energy will be provided by LEC in order to maximize the distribution of surplus heat energy into the wider community energy grid.

Retrofit. An energy upgrade of the existing facility, with 25% reduction in heating energy plus connection to LEC and 10% reduction in electricity.

Standard. New facility, assumed to have the energy consumption of a typical community recreation complex.**Energy Efficient**. 25% less energy consumed than Standard, through established energy conservation measures.

High Performance Building. 50% less energy consumed than Standard, through aggressive and leading edge energy reduction strategies.

High Performance with Heat Pump. 50% less energy consumed than Standard in non-heating loads. A 60% reduction achieved in heating energy through the use of an electric heat pump (air source or ground source).

Net Zero Building. A net zero energy building that purchases 10% of its energy from utilities, with corresponding sales.

Michael Wilson, P. Eng., October 15 2010

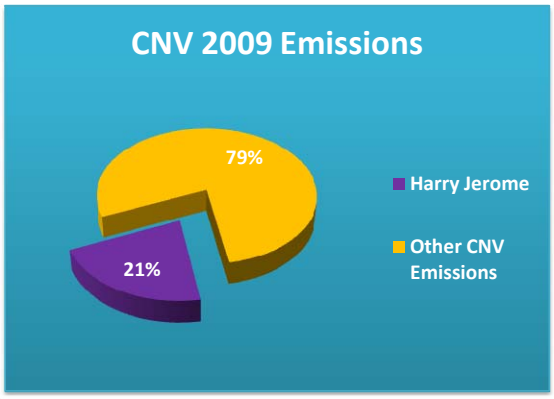
Harry Jerome Recreation Complex

(including Memorial Gym and Mickey McDougall)

Existing floor area: 123,000 ft²
New floor area (assumed): 100,000 ft²

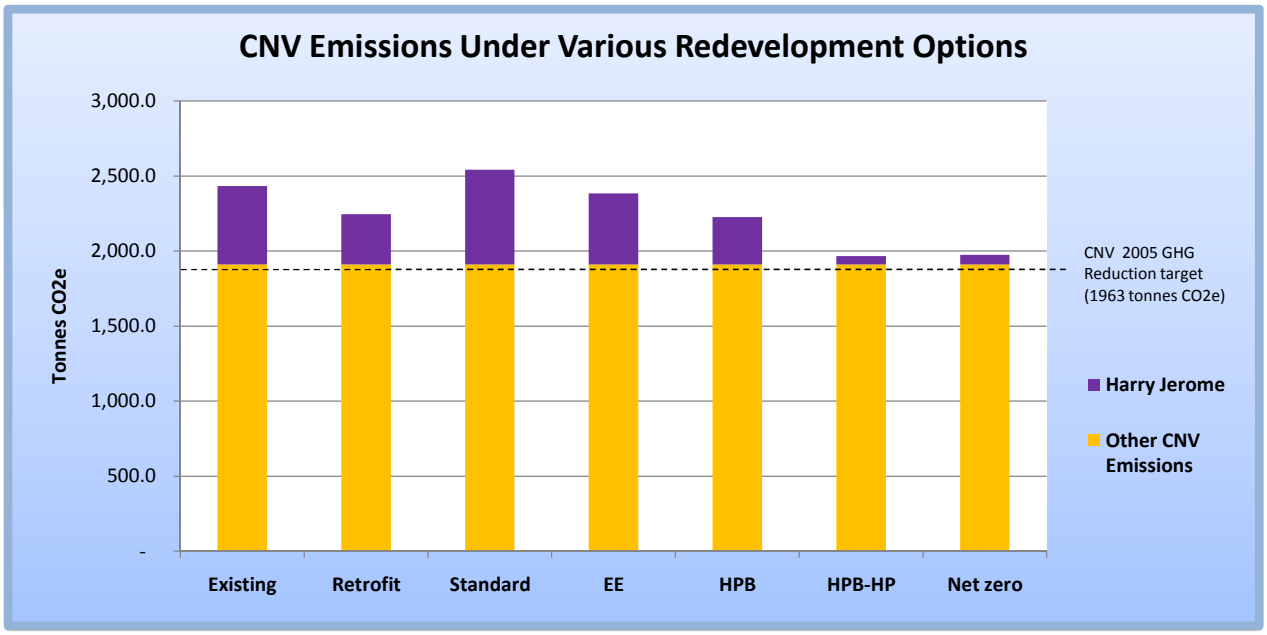
Consumption Data - 2009

Electricity	1,820,400	kWh	47.3	tonnes CO2e
Natural gas	7,559	GJ	474.2	tonnes CO2e
Total	14,112	GJ	521.5	tonnes CO2e



Redevelopment Options:

Existing	Current energy consumption of existing facility.
Retrofit	25% reduction in heating plus connection to LEC, 10% electricity reduction.
Standard	Energy consumption of a typical community recreation complex, with LEC used for heating.
Energy efficient	25% energy reduction vs Standard.
High Performance Building	50% energy reduction vs Standard.
High Performance - Heat Pump	60% heating reduction vs Standard through use of heat pump, 50% non-heating energy reduction.
Net Zero Building	90% energy reduction vs Standard, 10% energy sales with loss of carbon credits.



Enerficiency Consulting

Key Performance Indicators – City of North Vancouver 2010

Note: all KPIs are annualized based on input data for review period.

E3 Fleet has analyzed data provided for the City of North Vancouver fleet and identified 15 key indicators that provide a snapshot summary of operating parameters. These Key Performance Indicators (KPIs) reflect operating costs, emissions, service levels and in general, client satisfaction with your fleet. Making improvements to each of these will assist in stabilizing operating and capital budgets and reducing cost "spikes" from year to year.

Key Performance Indicator		E3 Fleet Analysis
1.	Fleet Median Fuel Efficiency (l/100km)	30.8
2.	Fleet Annual Fuel Usage (liters/yr)	204,796
3.	Fleet GHG Intensity (tailpipe)(kg/km)	0.866
4.	Annual GHG Emissions (tailpipe) Tonnes CO2 Equivalent	493
5.	Fleet GHG Intensity (lifecycle) (kg/km)	1.217
6.	Annual GHG Emissions (lifecycle) Tonnes CO2 Equivalent	693
7.	Corporate Average Utilization (kilometers)	7,294
8.	Corporate Average Utilization (hours)	n/a
9.	Fleet Average Age (years)	6.5
10.	Units due for Replacement	23
11.	Projected Capital Budget (based on current retention practices):	$1,028,000
12.	Projected annual cost of R&M, fuel, capital & downtime	$653,426
13.	Fleet Availability (%)	97.6
14.	Fleet Average Downtime (days)	6.3
15.	Maintenance Ratio (Preventative: Reactive)	0.27

Key Recommendations for Action – City of North Vancouver Fleet

The following recommendations for further action are based on the E3 team's review and assessment of data supplied, and current Key Performance Indicators. Implementing these recommendations will result is a more cost effective, more fuel efficient and lower emission fleet.

Exception Management

In the detailed E3 Fleet Review reports individual vehicles are compared to similar units within the fleet. E3 refers to this practice as "exception management". Exception management is an extremely valuable tool to attain peak performance in any fleet.

In all fleets there will be top performers and poor performers; these are the exception units. E3 Fleet Review has identified the exception units in the fleet, which enables a fleet's efficiencies to be improved and emissions and fuel costs reduced.

Parameter Ranking

Included in the E3 Fleet Review package of reports is one called "*Sorted Fleet Detail Sheet*." Within the *Sorted Fleet Detail Sheet* report, exceptions within your fleet are identified through parameter ranking. E3 automatically defaults to a 0.5 alert level for ranking, meaning that exceptions are below (or above) 50% of the average for your units. Parameter ranking identifies those units performing at a high level, those performing poorly as well as those performing satisfactorily.

Recommended Actions - Fuel Efficiency

1. **Investigate and take corrective actions** for each low fuel efficiency exception vehicle identified in your *Sorted Fleet Detail Sheet*. E3 Fleet Review has identified **12 units** with higher than average fuel consumption for vehicles within your fleet. Some corrective actions include fuel-efficient driver awareness training, vehicle repairs or maintenance, idling reduction programs, etc.

2. **Purchase** high efficiency/low emissions vehicles that meet operational needs e.g. hybrids, Smart cars. Battery-electric vehicles that consume no fossil fuel and produce almost zero emissions will soon be available for purchase. Use EnerGuide ratings for vehicles and E3 Fleet Review unit fuel consumption data when making purchasing decisions.

3. **Purchase** the best performing vehicle models when replacing vehicles in the same class.

4. **Investigate and take corrective actions** to improve overall Fleet Median Fuel Efficiency via initiatives such as idling reduction programs, vehicle pooling, trip reduction, route planning, etc

Recommended Actions - GHG Emissions

1. **Use alternative lower carbon fuels** that are available and where operationally practical. We support your use of B5 biodiesel in your diesel-powered vehicles and recommend that you consider using a higher blend such as B20.

2. Investigate the use of other alternative fuels where appropriate e.g. CNG, ethanol or propane.

3. **Consider switching to diesel engines** where operationally practical for future vehicle specifications as diesels are generally much more fuel efficient, delivering overall reduced GHG emissions relative to gasoline powered vehicles and also allowing for the use of renewable biodiesel. Modern diesels are equipped with particulate traps that have greatly reduced their smog causing emissions.

4. **Apply a carbon charge to user departments** placing corporate responsibility for GHG emissions with line departments.

Recommended Actions - Utilization

1. E3 Fleet review has identified **12 units** within your fleet that have **utilization at least 50% less** than similar vehicles in the fleet. This equates to over 15% of your fleet. We recommend a review to determine if there is a valid operational requirement for all vehicles. Optimizing utilization would free up capital for other worthwhile purposes such as fleet renewal with newer, more fuel efficient vehicles.

2. **Collect vehicle utilization data** from on board diagnostic (OBD) systems, Automatic Vehicle Location systems (if equipped) or engine hour meters and enter data into a database for future analysis.

3. **Report vehicle utilization** to the City's management team, as this will highlight under-utilized units and help determine if such vehicles are needed.

4. **Review the current vehicle charge-back system** to ensure that user departments pay the *true* cost of vehicle use encouraging fleet right-sizing and ensuring maximum utilization of all vehicles.

5. **Implement duty cycles for the fleet based on age** as high utilization applications are most cost effectively served by newer units

Recommended Actions - Capital budget and Vehicle Replacement

1. **Review current vehicle replacement and retention strategy.** Your current strategy will require capital funding of approximately $1,028,000 for 23 new vehicles, reduce the age of the fleet from 6.5 years to 3.3 years with benefits as follows:
    a. Decreased GHG output (81.9 tonnes)
    b. Fuel consumption reduction of 33,437 litres
    c. Reduced fuel costs of $28,768
    d. Cost of capital increase for the 23 new vehicles of $41,120
    e. A *net cost* <u>*decrease*</u> (when all factors are considered *including* cost of capital, repairs and all other op. costs) of $143,345/year

    Your current replacement strategy, if fully implemented will lead to some very positive outcomes. Another strategy to consider for the future is to replace units at the rate of depreciation. For example, if your fleet is depreciated over a five-year period, then your annual capital budget would be 20% of your fleet's current book value. For CNV this would be about $480,000. This approach would reduce and maintain your fleet's average age, stabilize and "flat-line" your capital spending in the years to come (except for inflationary increases), and avoid cost "spikes". Using this method, you would essentially be replacing vehicles at the rate they are wearing out – a very sustainable business plan. It would also maintain a high rate of uptime (availability).

It is very important to note that this strategy will only work if your fleet is at an average age whereby the availability (uptime) rate is at an acceptable level[1]. If it is not, and you wish to improve your uptime and service level for your fleet "customers", then a one-time spend may be necessary.

We strongly recommend that you complete an intensive **Life Cycle Cost Analysis** to fine-tune your current retention strategies and to further evaluate the options for replacement vehicles.

As you are no doubt aware, it is absolutely critical to know just how long to keep fleet vehicles in service. To make this assessment properly, one needs to consider:

- Historical operating (reactive repair) costs, by vehicle age
- Resale values for end of cycle units
- Uptime rates, by vehicle age
- Downtime costs, by vehicle age
- Utilization

E3 Fleet Review can complete an in-depth Life Cycle Cost (LCC) Analysis on a for-fee basis if you wish. LCC Analysis will pinpoint exactly the optimal time to replace your vehicles. Alternately, at no charge we can provide you with an LCC tool, which you can use to determine optimum life cycle yourself. Please contact us for either option.

2. **Make vehicle right-sizing a priority**. Select the right sized vehicles for the job at hand.

Recommended Actions - Fleet Availability and Downtime

1. We note that your **Availability** (uptime) rate is lower than typical and suggest that this may be partly due to your fleet being older on average than most municipal fleets. Downtime is costly as it can mean unproductive time for employees when vehicles are out of service for repairs. Therefore we recommend a review should be conducted, with a view to improving your rate. (see following section on Preventive Maintenance)

2. **Begin by regularly tracking availability/downtime on a go-forward basis,** as this information would provide an accurate picture of the business implications of future vehicle replacement.

3. **Next, once availability data is available, drill down and closely evaluate** vehicles with low availability. This may be a sign of an aging vehicle, insufficient preventative maintenance, a vehicle that is not correctly matched to the job at hand, an abusive driver or one who is prone to accidents, or a vehicle type with a low reliability history because of inherent mechanical problems. Excessive vehicle downtime may drive up overall operating costs to an unacceptable level and result in reduced service levels for your internal clients.

Recommended Actions - Preventative Maintenance

1. **Continue to track preventative and reactive maintenance costs separately** to assess effectiveness of PM programs and levels of intensity required to maintain the highest practical levels of service.

[1] Note: low availability may also be caused by inadequate preventive maintenance.

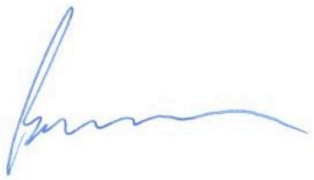
2. Your **PM Ratio (Preventive: Reactive),** is lower than average, meaning that your spending on preventive maintenance is less than average and your spending on reactive (unplanned) repairs is more than average. This could be one of the contributing factors for the reduced availability. While there is no perfect ratio to target, in the past we've noticed that a ratio of about .50 and up will lead to very high rates of availability. We suggest a review of the thoroughness and frequency of your preventive maintenance inspections.

3. **Include cost of maintenance as part of overall bid assessment for new vehicles** being considered for purchase. E.g. Extending oil drains and maintenance cycles can reduce overall operating expenses and environmental impacts.

After you've had the opportunity to review your E3 Fleet Review reports, if you have any questions or concerns, please feel free to contact me anytime.

Regards,

Roger



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City of North Vancouver City Hall Waste Audit Report

Prepared by: Amanda Vantol
North Shore Recycling Program
December 2010

Introduction

The City of North Vancouver contacted the North Shore Recycling Program in September 2010 to request a waste audit of City Hall. The audit was performed on Thursday, November 18, 2010 with the help of City staff. All the waste (garbage and recycling) produced in the Hall during Wednesday, November 17, was collected and sorted to determine City Hall's current waste diversion rate.

For the purposes of this report, waste refers to all material leaving the hall (garbage and recycling). Garbage refers specifically to material placed in garbage containers and recycling refers specifically to material placed in recycling containers.

Facility Overview

The City of North Vancouver City Hall is a two-storey building located in the City of North Vancouver. The majority of the Hall is accessible only by City Staff.

Garbage and mixed paper (office paper, cardboard and newspaper) is collected throughout the building and consolidated into larger containers on a daily basis. Pickup is once a week.

Blue box materials (rigid plastic containers #1, 2, 4 and 5, metal cans and glass bottles and jars) are emptied as needed by staff and collected by the North Shore Recycling Program along with mixed paper and newspaper.

Batteries and refundable beverage containers are collected by provincial product steward recycling agencies and materials acceptable at Pacific Mobile Depot are collected and returned on a voluntary basis by members of the City's Green Team.

There is currently no pickup for compostable materials.

Picture 1: *Waste Audit Sorting*

Method

All waste deposited into garbage containers on Wednesday, Nov. 17, 2010 was gathered and sorted into the categories listed in Table 1 *(see page 3)*.

Material placed in Recycling Containers was also weighed (and divided by the number of days it had been collected to get a daily weight) to determine the Hall's current diversion rate.

As seen in Picture 1 and 2, waste was dumped out onto a central tarp and then sorted by hand into labeled bins. This process was repeated three times, once for each area of the Municipal Hall: the lunchroom, the offices and the washrooms.

Disposable coffee cups were placed aside and counted.

Results

Complete results are listed in Attachment A.

A breakdown of the total waste produced by the Municipal Hall is shown in Chart 1. **This data includes materials put in both garbage and recycling containers.** See Attachment B for a separated breakdown of Garbage and Recycling.

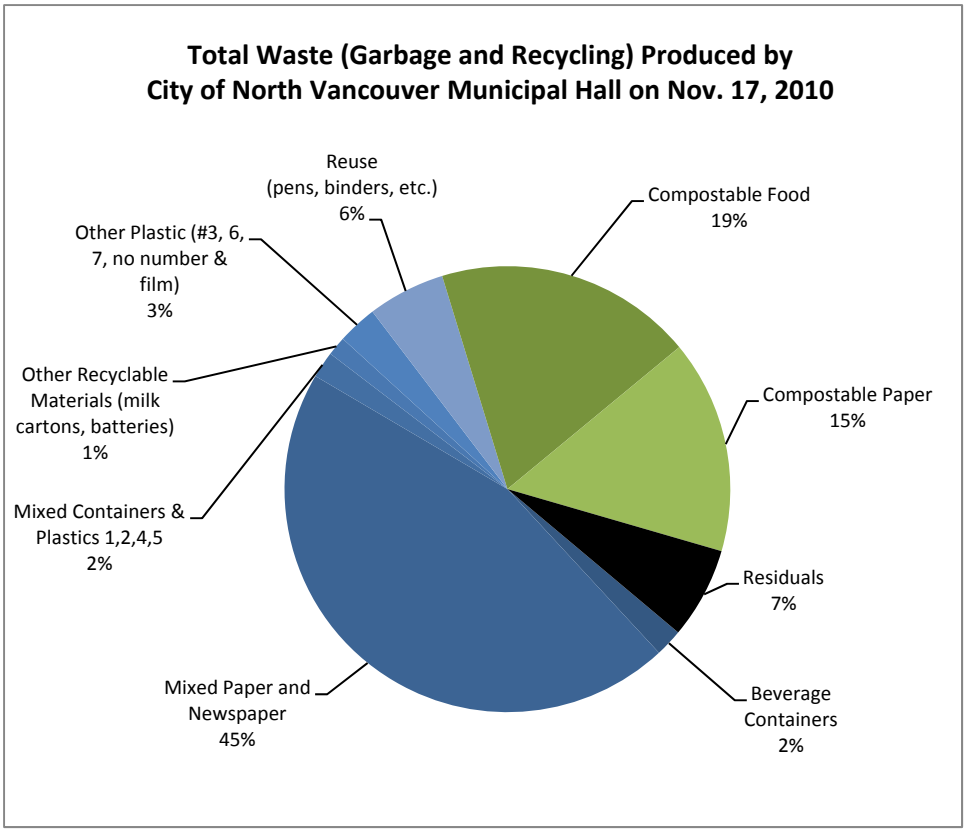


Chart 1: *Total Waste Produced by City of North Vancouver Municipal Hall on Nov. 17, 2010*

45% of the waste produced by this facility is mixed paper, which includes office paper, cardboard and newspaper. Beverage containers and blue box materials both make up 2% of the waste stream. Compostable food and paper make up 34% of the Hall's Waste Stream.

The remaining 17% of the waste stream includes predominately items that could have been reused and plastics not included in the blue box program.

45 coffee cups were found. 23 from the upstairs offices and 22 from the downstairs offices.

Based on the results from this single waste audit, the City of North Vancouver's Municipal Hall is currently diverting about 47% of waste produced. This means that out of all waste produced by City Hall staff and visitors, 47% is kept out of the garbage.

Picture 2: *Sorted Materials*

Discussion

Although the established diversion rate is only based on one day's worth of data, it does suggest that there is room for improvement at the Hall. Further accuracy could be achieved by performing repeat waste audits or by collecting material for a longer period of time. For the purposes of this project, the data collected gives a good approximation of current waste diversion and highlights areas where future programs could have a large impact.

As about 34% of Hall's Waste is comprised of compostable food or paper, a large amount of waste diversion could be accomplished by setting up a composting program or contracting a food waste collection

Category	Description
Compostable Paper	E.g. Paper coffee cups, napkins, paper plates
Compostable Food Scraps	E.g. Fruit scraps, old sandwiches
Blue Box Materials	Includes glass jars, tin cans and rigid plastic containers #1,2,4,5
Other plastics	Includes rigid plastic containers #3,6,7, no number plastics, Styrofoam and film plastic
Refundable Drink Containers	E.g. Pop bottles, juice containers, etc.
Mixed Paper	Includes cardboard
Newspaper	Currently included in Mixed Paper
Reuse	E.g. Clothes, books, pens
Other Recyclable Materials	E.g. Ink cartridges, electronics, milk containers
Residuals	Garbage that can't be recycled through municipal programs
Pacific Mobile Depot	E.g. Foil lined packaging
Coffee cups	

Table 1: *Sorting Categories*

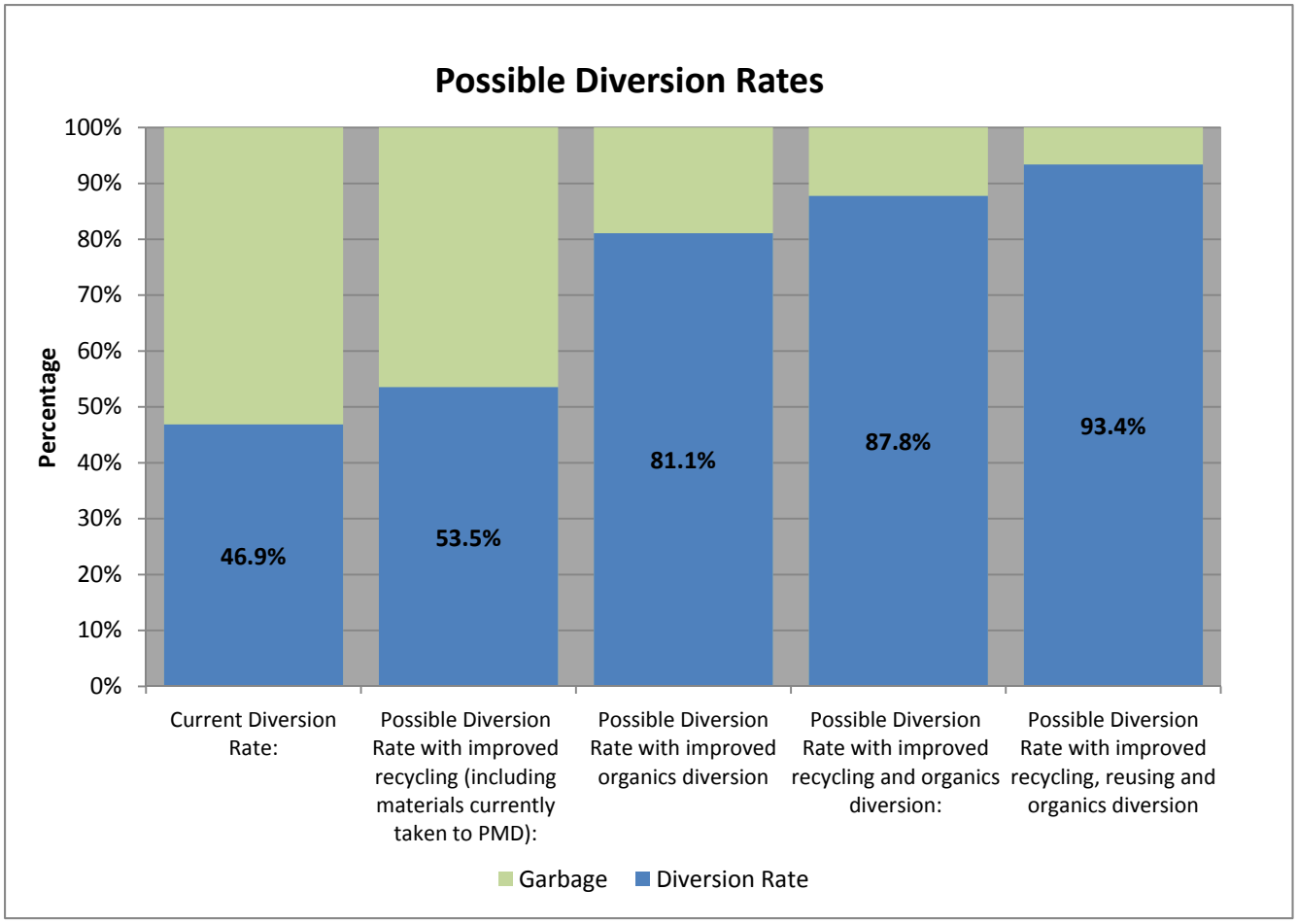


Chart 2: *Possible Diversion Rates*

company to collect compostable materials for delivery to a composting facility. As 100% of the waste collected from the washrooms was paper towels (*See Picture 3*), a compost collection program would result in a diversion rate of 100% from the washrooms (not including sanitary containers). Other options to look into are reusable towel dispensers or hand blowers for the washrooms.

Based on this audit, the Hall is doing an excellent job at recycling mixed paper. 45% of the waste produced by the Municipal Hall is mixed paper and almost 95% of this paper is being put in recycling bins.

The remaining 5% of paper is put in garbage cans. Although this is not a huge amount, there is still room for improvement. Enhanced paper recycling would improve the Hall's diversion rate and help the City of North Vancouver abide by the disposal bans that have been put in place by Metro Vancouver.

Picture 3: *Staff member Julie Cecchetto holding one day's worth of paper towels*

There is also some room for improvement in blue box material recycling. About 20% of this material is still going in the garbage.

Some of the material collected by the Hall is currently being recycled at Pacific Mobile Depot. There is a charge for recycling material this way, so a better solution would be to work on reducing these materials in the first place.

If all recyclable materials were recycled, the Hall could achieve a diversion rate of 53.5% *(See Chart 2)*. With composting collection program, this rate could reach 87.8%. Ensuring all reusable items are reused or donated to a local second hand store could increase the diversion rate to an astonishing 93.4%. Further changes in purchasing habits could push the rate even higher.

Picture 4: *City Hall Lunch Room*

The Hall is already doing a good job at promoting reusable items such as coffee spoons and condiment containers (*See Picture 4*). The City is moving away from single use sugar packets by offering sugar in refillable containers.

The Hall is also doing a great job with Battery Recycling. No batteries were found in the garbage on waste audit day.

Recommendations

1. *Look for opportunities to reduce waste.*
   a. Implement sustainable purchasing habits
   b. Set printing default to two-sided printing
   c. Expand good one-sided paper collection and use
   d. Look for opportunities to eliminate or reduce printing
   e. Consider adopting a "zero waste meetings" policy so that reusable mugs and plates are used for meetings, avoiding waste generation
   f. Promote reusable mugs for take-out beverages
   g. Ensure all plastics purchased for the Hall are recyclable (# 1, 2, 4 or 5)

2. *Improve Recycling*
   a. Ensure all garbage bins are “twinned” with recycling bins *(See Picture 5).* Start with ensuring all garbage cans have a paper recycling bin beside them. Consider creating recycling “stations” that would include bins for multiple recyclable materials.
   b. Improve Signage. Signs should be visible and clearly show what can and what cannot be placed in the bin. Pictures can prove helpful.
   c. Consider standardizing recycling bins (Size, shape, colour and place)
   d. Consider providing recycling collection for blue box materials in more areas of the Hall.
   e. Educate staff about what can be included in each recycling container (Most of the paper in the garbage was not office paper, but other types of recyclable paper such as cardboard coffee cup sleeves, tea boxes and other paper that is not waxed or foil-lined).

Picture 5: “Twinned” Bins

3. *Look into Organics Diversion*
   a. Consider diverting organics via an on-site composting program or a collection service for organics

4. *Engage Staff*
   a. Work with the entire staff to set a goal for waste diversion. Be sure to communicate any changes to the waste diversion program with staff and ask for input on a regular basis.
   b. A repeat waste audit after improvements have been made can help staff see the results of their work and celebrate their achievements.

Conclusion

The City of North Vancouver is doing a great job at waste diversion, but has a wonderful opportunity to further reduce its waste and become a showcase in sustainability. With a few small changes and an innovative mindset, this municipal headquarters can become a role model for waste diversion in our community.

Appendix A:

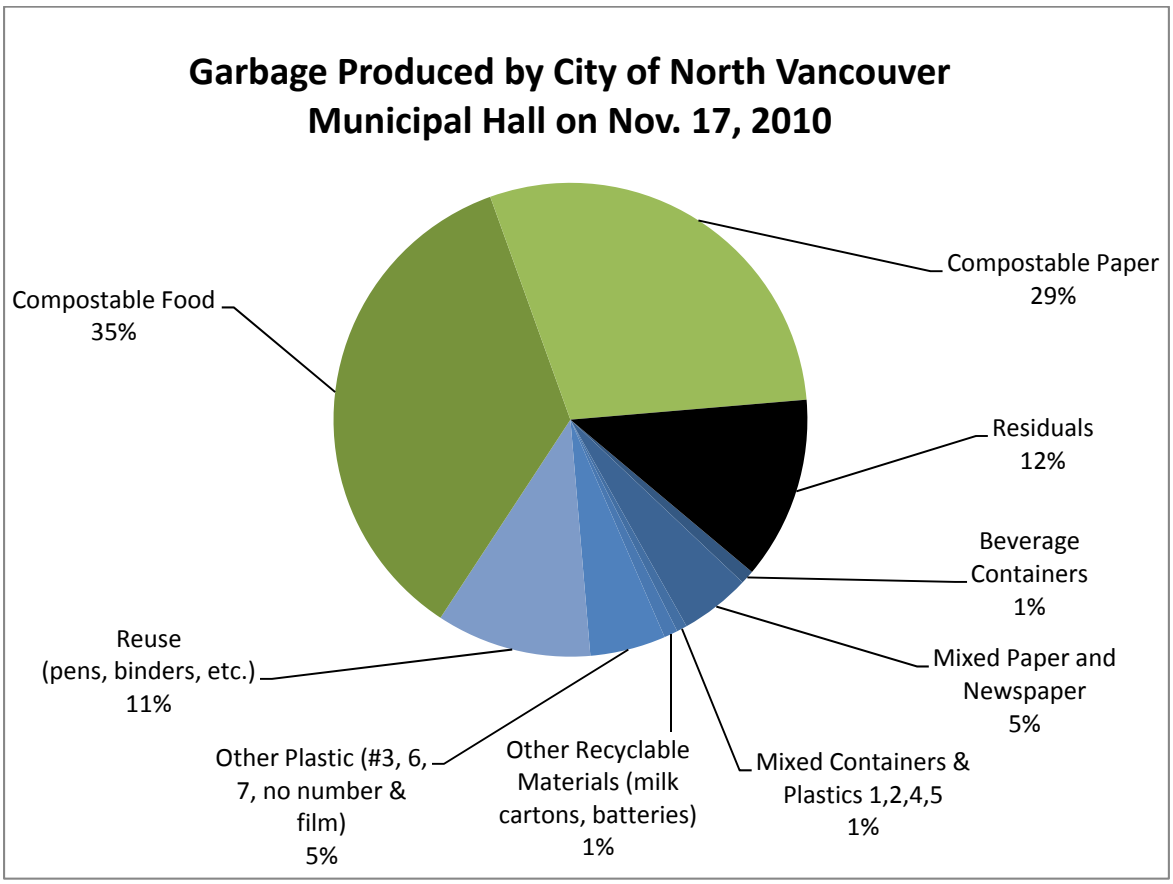
City Hall Waste Audit Data

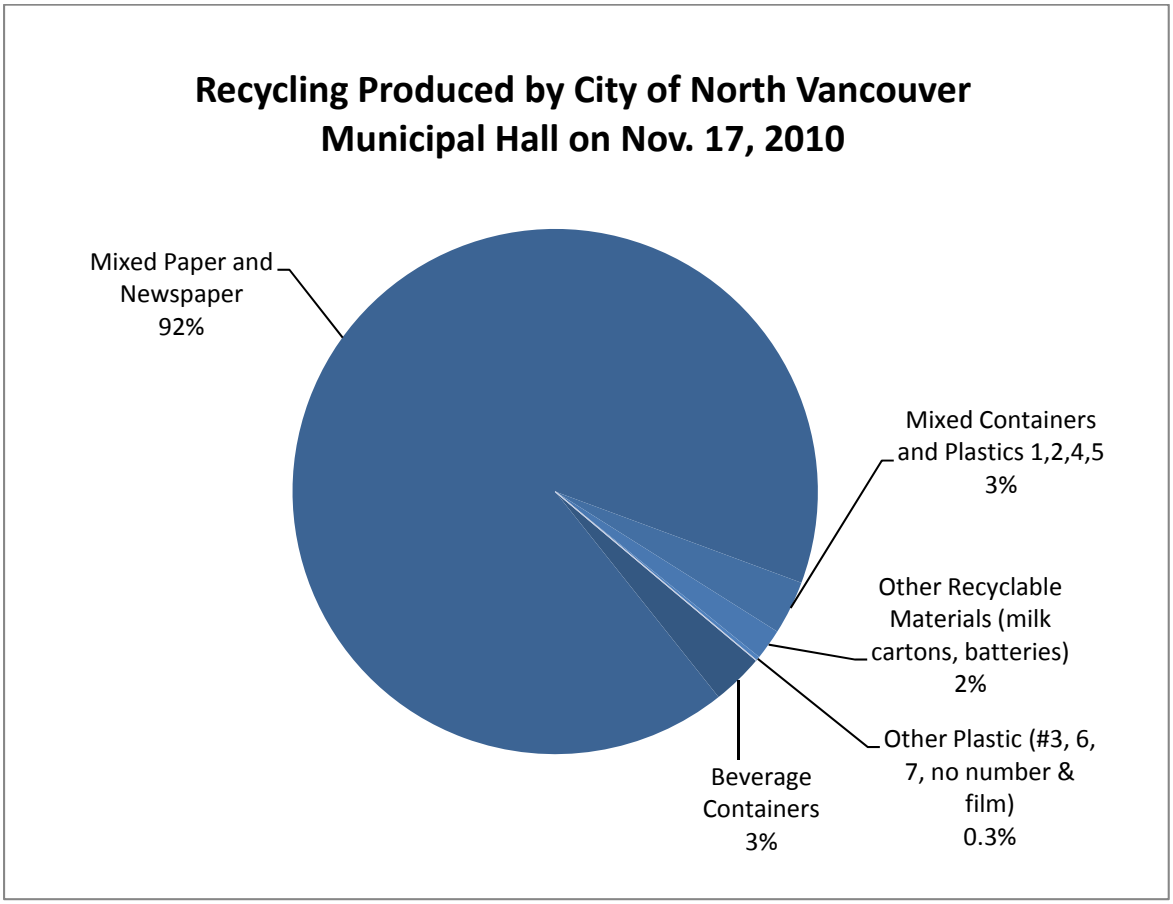
Nov. 18, 2010

Waste audit includes material from one day's worth of waste generated at the Hall.

	GARBAGE LUNCHROOM				GARBAGE OFFICES				GARBAGE WASHROOM				GARBAGE TOTAL			RECYCLING TOTAL			TOTAL WASTE			
Materials	Weight (Kg)	% of Lunch room Garbage	% of Total Garbage	**% of Total Waste**	Weight (Kg)	% of Office Garbage	% of Total Garbage	**% of Total Waste**	Weight (Kg)	% of Wash-room Garbage	% of Total Garbage	**% of Total Waste**	Actual (Kg)	% of Garbage	**% of Total Waste**	Actual (Kg)	% of Recyc-ling	**% of Total Waste**	Actual (Kg)	% of Total Waste	% of Total Waste going in Garbage	% of Total Waste going in Recycling
Beverage Containers	0.00	0.0%	0.0%	**0.0%**	0.20	1.9%	2.7%	**0.5%**	0.00	0.0%	0.0%	**0.0%**	0.20	0.9%	**0.5%**	0.60	3%	**1.5%**	0.80	2.0%	25.0%	75.0%
Mixed Paper and Newspaper	0.22	3.0%	3.0%	**0.5%**	0.80	7.5%	10.9%	**2.0%**	0.00	0.0%	0.0%	**0.0%**	1.02	4.8%	**2.5%**	17.14	91%	**42.8%**	18.16	45.4%	5.6%	94.4%
Mixed Containers & Plastics 1,2,4,5	0.10	1.4%	1.4%	**0.2%**	0.05	0.5%	0.7%	**0.1%**	0.00	0.0%	0.0%	**0.0%**	0.15	0.7%	**0.4%**	0.62	3%	**1.5%**	0.77	1.9%	19.5%	80.5%
Other Recyclable Materials (milk cartons, batteries)	0.10	1.4%	1.4%	**0.2%**	0.10	0.9%	1.4%	**0.2%**	0.00	0.0%	0.0%	**0.0%**	0.20	0.9%	**0.5%**	0.35	2%	**0.9%**	0.55	1.4%	36.1%	63.9%
Other Plastic (#3, 6, 7, no number & film)	0.10	1.4%	1.4%	**0.2%**	1.00	9.4%	13.7%	**2.5%**	0.00	0.0%	0.0%	**0.0%**	1.10	5.2%	**2.7%**	0.05	0%	**0.1%**	1.15	2.9%	95.7%	4.3%
Reuse (pens, binders, etc.)	0.05	0.7%	0.7%	**0.1%**	2.20	20.7%	30.1%	**5.5%**	0.00	0.0%	0.0%	**0.0%**	2.25	10.6%	**5.6%**	0.00	0%	**0.0%**	2.25	5.6%	100.0%	0.0%
Compostable Food	5.20	71.0%	71.0%	**13.0%**	2.30	21.6%	31.4%	**5.7%**	0.00	0.0%	0.0%	**0.0%**	7.50	35.3%	**18.7%**	0.00	0%	**0.0%**	7.50	18.7%	100.0%	0.0%
Compostable Paper	1.30	17.8%	17.8%	**3.2%**	1.60	15.0%	21.9%	**4.0%**	3.30	100.0%	45.1%	**8.2%**	6.20	29.1%	**15.5%**	0.00	0%	**0.0%**	6.20	15.5%	100.0%	0.0%
Residuals	0.25	3.4%	3.4%	**0.6%**	2.40	22.5%	32.8%	**6.0%**	0.00	0.0%	0.0%	**0.0%**	2.65	12.5%	**6.6%**	0.00	0%	**0.0%**	2.65	6.6%	100.0%	0.0%
Total	7.32	100.0%	34.4%	**18.3%**	10.65	100.0%	50.1%	**26.6%**	3.30	100.0%	15.5%	**8.2%**	21.27	100.0%	**53.1%**	18.76	100%	**46.9%**	40.03	100.0%		

Current Diversion Rate:	**46.9%**
Possible Diversion Rate with improved recycling (including materials currently taken to PMD):	53.5%
Possible Diversion Rate with improved organics diversion	81.1%
Possible Diversion Rate with improved recycling and organics diversion:	87.8%
Possible Diversion Rate with improved recycling, reusing and organics diversion	93.4%


Garbage Produced by City of North Vancouver Municipal Hall on Nov. 17, 2010
Compostable Paper 29%
Residuals 12%
Beverage Containers 1%
Mixed Paper and Newspaper 5%
Mixed Containers & Plastics 1,2,4,5 1%
Other Recyclable Materials (milk cartons, batteries) 1%
Other Plastic (#3, 6, 7, no number & film) 5%
Reuse (pens, binders, etc.) 11%
Compostable Food 35%


Recycling Produced by City of North Vancouver Municipal Hall on Nov. 17, 2010
Mixed Paper and Newspaper 92%
Mixed Containers and Plastics 1,2,4,5 3%
Other Recyclable Materials (milk cartons, batteries) 2%
Other Plastic (#3, 6, 7, no number & film) 0.3%
Beverage Containers 3%

Summary of Staff Corporate Climate Action Engagement
March 17, 2011

A major component of the Corporate Climate Action Plan update was to consult with all City staff to provide the opportunity for everyone to inform the development of the plan. During the months of November 2010 – March 2011, in-depth interviews were held with all Directors, Department Managers and key staff at all City facilities (City Hall, Works Yard, RCMP, Fire Hall, Library, and Recreation Centres) to obtain their input. Information sessions were also held with key groups responsible for larger energy use (e.g. Engineering Operations/Parks, Corporate Services – Facilities/IT, Recreation) and a questionnaire was circulated to staff at all City facilities to ensure all had the opportunity to provide feedback.

- **Departments and facilities engaged:** Corporate Services (Facilities, IT, Communications), Community Development, Engineering, Parks & Environment, Finance, Human Resources, City Clerk's, City Manager's Office, RCMP, Fire Hall, Library, Recreation Centres
- **Number of staff interviewed:** 32
- **Staff questionnaire respondents:** 23
- **Staff engaged through information sessions:** Engineering all-staff Meeting, All Parks End of Season Meeting, Corporate Services Staff Meeting, Foreman's Meeting, Recreation Coordinators Meeting, and Recreation Maintenance Crews Meeting (combined, these information sessions provided an opportunity to reach approximately half of all City staff)

There were two important elements of this engagement:
1) **Staff Input into Plan Development:** Staff were asked to provide input into the development of the Corporate Climate Action Plan, including an assessment of current City achievements in reducing energy and emissions, and identifying opportunities and challenges for energy and emissions reduction actions. Information obtained has been incorporated into the plan to inform the development of specific actions for reducing energy, emissions and waste.
2) **Development of Staff Behaviour and Awareness Program:** Staff were also asked to provide input on the most effective tools and channels of communication for ongoing awareness and engagement, to inform the development of an ongoing staff behaviour and awareness program.

A summary of the findings of the staff engagement are provided below.

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1) Staff Input into Plan Development

Key opportunities for reducing energy, emissions and waste that were identified during interviews, input sessions, and through the on-line questionnaire are as follows:

<u>Opportunities for Energy and Emissions Reductions</u>

Efficiency and Reductions
Buildings
- Implement a comprehensive building retrofit program
- Examine the potential for retrofits and upgrades in all existing facilities: assign a probability for building rebuild/replacement and on this basis plan for either inclusion in comprehensive retrofit or exclusion based on planned future replacement

- Continue facilities lighting and occupancy sensor upgrades, building monitoring (heating and cooling controls), window retrofits and glazing upgrades
- Broaden facilities management so City is responsible for maintenance of all buildings
- Reduce individual energy use (computer and monitor shut-downs, heaters, fans, task lighting)
- Manage data storage to reduce energy need and cost (i.e. emails, CityDocs)
- Consider server heat reuse opportunities

Fleet and Transportation

- Enhance fleet efficiency, including: right-sizing, trip management, increased seating to promote carpooling to sites and reduce number of vehicles used, traffic pre-emption for fire vehicles
- Increase parameters in purchasing policies (e.g. fuel efficiency standards, recycled materials, sustainably managed forests, etc.)
- Provide driver training for safety and fuel efficiency
- Provide and promote electric bicycle training and use
- Consider positive impact on maintenance schedules and cost savings for green (energy savings) projects
- Consider operational and design changes (i.e. increase low maintenance landscaping)
- Consider alternative technologies for street lighting (e.g. higher efficiency LED)
- Encourage better use of pool vehicles and public transit to off-site meetings (passes, extra time)
- Increase opportunities for webinars, conference/video meetings, Skype interviews, and telecommuting

Waste

- Start food scraps collection at City facilities
- Provide more recycling infrastructure at all City facilities
- Decrease garbage collection to bi-weekly and reduce kms traveled for garbage trucks
- Promote side-casting of native material for reuse, and on-site composting in parks and community gardens
- Move towards paperless systems (e.g. reduce margins on templates, e-agendas for Council meetings, reduce and condense Council packages and re-configure developer drawings process to eliminate waste, reduce number of Council packages provided to staff, training on Adobe editing software, HR online self-serve functions, electronic RFPs, permits, etc.)
- Reduce printing (e.g. prompts re: most economical printing options, reduce plug load electricity through reducing the number of individual printers in offices)
- Reduce paper towel use in bathrooms; consider hand-dryers

Monitoring and Reporting

- Enhance DDC (Direct Digital Control) energy reporting for all facilities with user-friendly graphic outputs for staff of building energy use
- Enhance detailed and accurate data collection and reporting (e.g. fuel use)
- Track fleet route planning (grouping crews, stacking trips) and idling
- Consider using energy meters for computers to assess power usage
- Track printing and paper use and cost

Technologies

- Purchase more electric vehicles, bicycles and portable equipment
- Consider biomass opportunities for LEC to generate energy

- Consider use of paving alternatives to concrete
- Purchase rugged notebooks for foremen to reduce trips from works yard to site and increase efficiency
- Integrate emissions life cycle assessments in decision-making

Incentives (financial and other)

- Provide mileage compensation for riding electric bicycles instead of personal vehicles
- Provide commuting incentives (e.g. increased transit subsidies, pay parking)
- Consider supporting flexible scheduling to align with transit schedules
- Use money from recycling refundables to fund plastic recycling, or give to charity

Challenges to Achieving Energy and Emissions Reductions

Key challenges for reducing energy, emissions and waste that were identified and incorporated into the plan are as follows:

Operational

- Lack of staff resources and money to implement energy projects
- Managing behaviour of buildings if the City is paying the energy bills instead of the tenant (disconnect between energy use and impact of actions)
- Shared operation and cost-sharing of recreation facilities because the City does not immediately benefit from future energy savings
- 24-hour operational requirements at RCMP and Fire Halls
- Uncertainty of new technology

Financial

- Lack of priority for energy projects in budget process (i.e. GHG reduction potential should be more of a key factor in decision-making)
- Long paybacks for energy projects might be hard to justify in budget process, but should consider the potential to have a separate list of energy projects with both cost and GHG paybacks
- Lack of funding in the operational/maintenance budget could be addressed by considering energy projects as capital projects
- Lack of financial incentives to reduce energy and emissions

Policies and Governance

- Certain policies make potential changes to operations challenging (e.g. personal vehicle provisions, carpooling limitations, etc.)
- Union agreements provide challenges to telecommuting opportunities, but better evaluation and performance assessment processes could help overcome this
- Increased senior management buy-in and endorsement of initiatives could help drive energy initiatives forward

2) Development of Staff Behaviour and Awareness Program

Key challenges to behaviour change that emerged from the staff engagement include: the lack of awareness of what individuals can do to reduce energy and emissions and the actual savings of specific actions; perceptions of appropriate energy and emissions standards/levels; and lack of communication and connection between all facilities (i.e. RCMP, Fire Hall, Library) and departments. Key opportunities and actions to overcome these challenges were identified as follows:

Reporting and Feedback

- Provide more regular communication and bridging between all departments and City facilities (i.e. a monthly newsletter with facts, tips and events)
- Report on energy use/day/department (e.g. printer and photocopy use, fuel use and cost when staff fuel fleet vehicles, etc.)
- Include rationale for why actions are important, and tie in messaging regarding efficiency, productivity and associated decreases in GHGs and cost
- Make numbers relevant (i.e. 1 tonne CO_2e = 424 litres of gasoline consumed)
- Highlight connections to providing a sustainable future for generations to come and impacts of our actions; draw personal connections to actions people can do at home
- Increase awareness of the City's vision and integrate with the OCP
- Compare with other municipalities to increase spirit of competition

Visible Displays and Demonstrations

- Set up posters and interpretive signage in all facilities
- Provide energy monitoring displays on CityBizz and in lobbies so staff can observe energy use
- Develop a GHG tracker and/or carbon footprint calculator on CityBizz
- Develop authentic branding that resonates with staff and connects climate action initiatives
- Showcase green features of facilities and City initiatives (e.g. interpretive signage at Library, logos on hybrids, etc.)

Education

- Provide ongoing department presentations/engagement sessions and events; provide targeted outreach for each department to make it relevant, but ensure we aren't reinforcing silos
- Conduct workspace and jobsite energy and emissions audits
- Focus on one key message at a time to avoid overload (i.e. engaging monthly challenges for waste, energy, commuting, etc.)
- Eliminate energy myths (i.e. turning off computer monitors doesn't save substantial energy)
- Increase access to CityBizz and sustainability resources for all City facilities
- Provide adequate training to staff when any operational changes related to energy are made
- Increase awareness of new technologies and climate action-related opportunities for all staff
- Provide more avenues for staff to contribute and share climate action ideas (i.e. regular energy and emissions brainstorming at department meetings)

Incentives

- Set pledges, goals and benchmarks with attainable rewards and celebrations of success
- Maintain momentum, pride in actions, and positive messaging
- Post and promote available energy efficiency incentives on CityBizz

Leadership/Ownership

- Provide support to energy champions in each building/department to encourage action
- Ensure top-down leadership; engage Directors and Managers to encourage action in individual departments
- Recognize and reward climate action heroes; support Green Team efforts
- Start a staff-initiated nomination process to recognize staff initiatives
- Ensure we are all walking the talk

Appendix 1: Staff Interview Questions

1) What in your opinion are some significant steps the City has taken to reduce energy and emissions in its operations?

2) What opportunities do you see for additional energy and emissions reduction initiatives in your department? Consider specific actions, policies, and procedures.

3) What barriers exist that might be preventing your department from achieving energy and emissions reductions? Consider policies, operational procedures, and budgets.

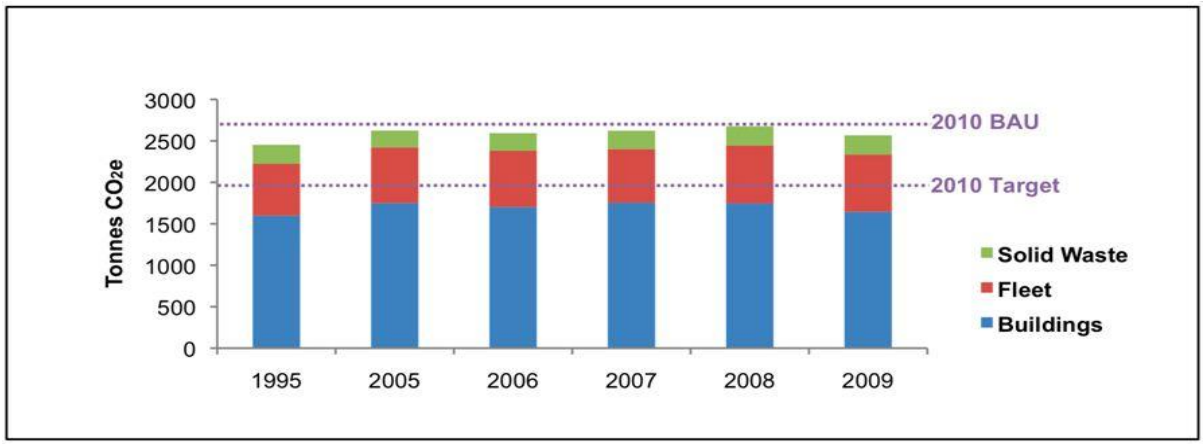
4) What do you think are the most effective ways to engage with staff and communicate with regard to these opportunities?

5) Any further comments or suggestions for the Corporate Climate Action Plan update?

Appendix 2: Corporate Climate Action Plan – Questionnaire for Staff

The City is currently updating its Corporate Climate Action Plan, which will set new, ambitious reduction targets and a plan of action to reduce energy and greenhouse gas (GHG) emissions in our municipal operations. Corporate GHG emissions are those the City creates through its activities and those it has control over, such as City buildings, equipment, vehicle fleet, garbage and recycling, staff commuting, and paper use.

The City's corporate GHG emissions are already very low at approximately 2,500 tonnes of CO2e. 64% of our emissions come from buildings, 27% from vehicle fleet, and 9% from solid waste. Since 1995 our emissions have remained relatively stable. In 2009 the City achieved a 4% reduction in emissions through the implementation of a number of significant reduction actions in facilities, public works and fleet operations.



We need your help to identify ways we can reduce our energy, emissions and waste. How can we reach our targets? What is standing in our way? What could make your job easier while also helping to reduce energy, emissions and waste? We will only be able to achieve our goals if we all work together, and your input will help us develop the most effective plan we can to ensure we get there.

Please fill out the following questions by *Friday, March 11, 2011*:

1. **What do you think are some steps the City has already taken to reduce energy and emissions in its operations?**
2. **Do you have any suggestions for how we can further reduce energy, emissions and waste in our operations?**
3. **What are some barriers that might be preventing us from reducing energy, emissions and waste?**
4. **What would you consider to be good incentives to encourage reductions in energy, emissions and waste?**
5. **How would you like to hear about the City's corporate climate action initiatives?**
6. **Any further comments or suggestions for the Corporate Climate Action Plan update?**