Corporate Climate Change Plan

An Energy and Emissions Management Plan

2007

Regional District of Nanaimo

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Prepared for:

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January 25, 2007

Acknowledgements

Regional District of Nanaimo staff are gratefully acknowledged for their efforts in the development of this plan.

This study has been produced with the assistance of the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Financial assistance was also provided by the British Columbia Provincial Ministry of Environment.

Acronyms

CO_2 – Carbon Dioxide
CO_2e– Carbon Dioxide equivalent
FCM – Federation of Canadian Municipalities
GHG – Greenhouse Gas
GMF – Green Municipal Funds
PCP – Partners for Climate Protection
RDN – Regional District of Nanaimo

Preface

The Regional District of Nanaimo (RDN) recognizes climate change as a global issue that can be addressed at the local level if all local governments in Canada begin to effectively manage their emissions through responsible energy management.

The Regional District continues its leadership role in sustainability practices by developing this Corporate Climate Change Plan and making a commitment to embed energy and emissions management into its day-to-day operations.

The Regional District of Nanaimo's Corporate Climate Change Plan 2007 is the first in a series of plans to be developed as part of a commitment to Partners for Climate Protection (PCP). Five corporate plans will be developed, one for each RDN member municipality, and one community plan will be developed that will serve the entire region. The plans will provide the guidance necessary to implement measures designed to reduce energy consumption, energy costs, and greenhouse gas emissions.

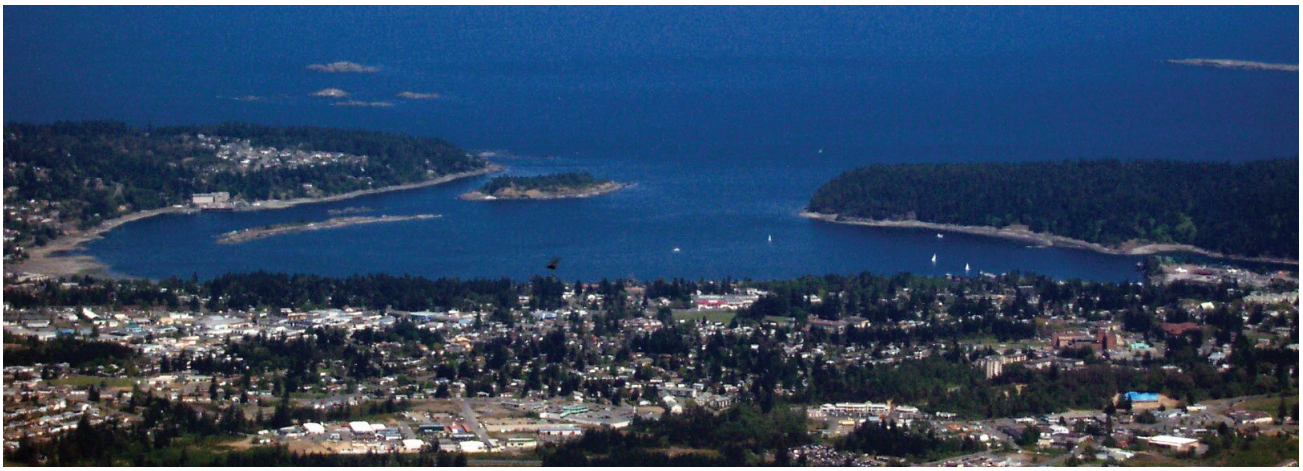
Partners for Climate Protection is led by the Federation of Canadian Municipalities (FCM) and ICLEI-Local Governments for Sustainability. Over 140 local governments across Canada have committed to achieving the five milestones of Partners for Climate Protection and more than 600 communities around the world have committed to ICLEI's Cities for Climate Protection. Once submitted, this Corporate Climate Change Plan will result in the Regional District of Nanaimo's recognition from the Federation of Canadian Municipalities for completing the corporate portion of Milestones One, Two and Three of Partners for Climate Protection.

Developing six plans is an ambitious undertaking. The Regional District not only recognizes the importance of developing such plans, but more importantly, the value of developing capacity among staff to manage energy and emissions. Staff have chosen the reduction measures that appear in the plan and take ownership of the measures that apply to their respective departments.

The RDN is producing five corporate plans from a common template to increase the efficiency of the process. Although the plans are similar in format, they are community-specific.

Estimates of reductions have been provided given knowledge of individual facilities, although detailed audits were not undertaken. The estimates have been developed to provide staff with a sense of the overall potential for reductions. A successful program will explore all the reduction measures listed as well as new opportunities that arise as new technologies are introduced.

The Federal Government has recognized the important role of local governments in supporting emission reductions and is providing funding for sustainable infrastructure under the New Deal for Cities and Communities. Funding provided in the New Deal presents opportunities for local governments that are committed to climate change action. Due to staff's ability to monitor and report energy consumption and emissions, the RDN is in a better position to receive funds as it is well positioned to quickly respond to the energy and emissions reporting requirements of successful New Deal Fund projects.



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Executive Summary

In 2002, the Regional District of Nanaimo made a voluntary commitment to participate in the Partners for Climate Protection Program. The Board's commitment to this program demonstrates its leadership among local government in British Columbia to improve the quality of life of its residents.

In 2004, the Regional District of Nanaimo's total energy consumed was 118,603 gigajoules (GJ), the total cost for consumption was $1,655,197, and the base year emissions quantity was 5,597 tonnes carbon dioxide equivalent (CO_2e). The majority of energy consumed, costs for energy, and emissions was generated by the vehicle fleet, which includes transit buses - a corporate function for which the Regional District is responsible.

A forecast of energy consumption, costs for consumption, and emissions has been calculated. In 2012, the forecast of energy consumed is 139,005 GJ, the forecast for costs for consumption is $5,539,810, and the forecast of emissions is 6,717 tonnes CO_2e.

While energy consumption and emissions are projected to increase by 17 percent and 20 percent respectively, of note is the projection for energy costs– an increase of over 235 percent, further emphasizing the immediate need to establish best management practices for energy use, especially for transit buses. By doing so, the Regional District will be well positioned to manage the rising costs of fuel that are certain in our immediate future.

Forecasted Parameter	Base Year (2004)	Forecast Year (2012)	Percent Change
Energy Consumption	118,603 GJ	139,005 GJ	17%
Energy Costs	$1,655,197	$5,539,810	235%
Emissions	5,597 tonnes CO_2e	6,717 tonnes CO_2e	20%

Notwithstanding the need for provincial and federal assistance to accomplish more, the Regional District of Nanaimo can reduce its 2004 base year emissions quantity of 5,597 tonnes CO_2e by 1,326 tonnes or 4 percent by 2012. The reduction quantity factors in all growth forecasts. Following is a summary of emissions growth forecasts by corporate sector:

Sector	2004 Base Year Emissions (tonnes CO_2e)	2012 GHG Projection (tonnes CO_2e)	GHG Reductions from Emissions after Projected Growth (2012)	GHG Emissions after Measures (2012)	Percent Reduction From Projected Emissions (2012)
Buildings[1]	725	912	501	411	-43%
Lighting[2]	10	11	9	2	-77%
Water and Wastewater[3]	233	245	30	216	-7%
Vehicle Fleet[4]	4,559	5,471	769	4,702	3%
Corporate Waste	70	76	18	58	-17%
Total	**5,597**	**6,716**	**1,326**	**5,389**	**-4%**

[1]The projection for buildings includes a proposed 25– metre pool and 14,500 sq. ft. expansion to the Ravensong Aquatic Centre.

[2]LEDs for ornamental and overhead lighting are not currently cost effective, although this is expected to change during the project period and should be monitored by staff.

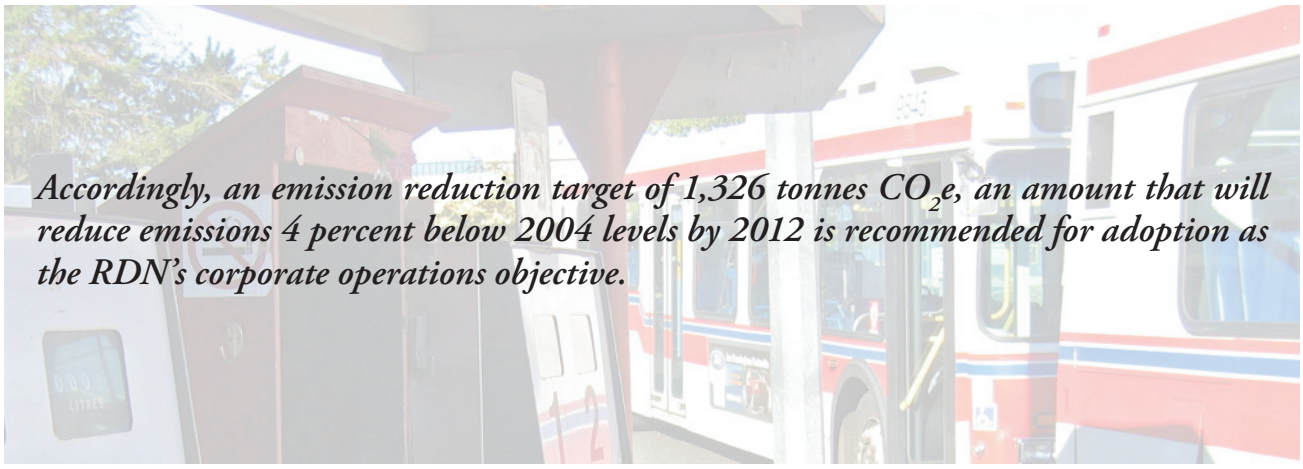
[3]A rough estimate is provided in the water and wastewater sector since the volume of potable water was not available and must be used as an indicator for specific measures.

[4]The reductions for the vehicle fleet may be underestimated given the technological breakthroughs expected in this sector within the next five years.

To be successful, the following is recommended:

1. Ensure that energy and emissions management becomes part of the daily activities of RDN staff so that energy and emissions are continuously monitored and reported as appropriate;
2. Initiate energy efficiency policies and programs beginning with the reduction initiatives identified by the project team and described in section 6 of this report;
3. Minimize growth in energy consumption, costs and emissions by adopting aggressive energy efficient standards for new corporate buildings and additions/renovations of existing buildings;
4. Reduce overall emissions and costs in the vehicle fleet sector by focusing attention on diesel fuel for transit buses– especially if growth in the number of transit buses operating follows the forecasts for population growth in the RDN. Notwithstanding any special emphasis on transit buses, the RDN should begin to infill the corporate operations fleet with hybrid vehicles;
5. Reduce overall emissions and costs in the buildings sector by focusing attention on natural gas consumption at Ravensong Aquatic Centre and Oceanside Place;
6. Assign responsibility for energy and emissions monitoring and reporting within the existing staff establishment and create an interdepartmental managers committee to coordinate and oversee the implementation of reduction initiatives.

In the absence of any growth from 2004 to 2012, which is unlikely, a 1,326 tonne reduction of the 2004 base year quantity is an overall 24 percent reduction. Regional District of Nanaimo staff are confident that the reduction quantity is achievable within reasonable program resources and with the commitment from the Board and management to undertake the programs proposed herein.



Accordingly, an emission reduction target of 1,326 tonnes CO_2e, an amount that will reduce emissions 4 percent below 2004 levels by 2012 is recommended for adoption as the RDN's corporate operations objective.

1 Introduction

The Regional District of Nanaimo Board (the Board) made a commitment to address the issues of climate change and clean air planning by endorsing participation in the Federation of Canadian Municipalities' (FCM) Partners for Climate Protection (PCP) initiative in November 2002. Along with its member municipalities, the Regional District of Nanaimo recognizes that climate change is occurring and the importance of strengthening its overall sustainability program by developing a Corporate Climate Change Plan 2007 (the plan).

As energy prices continue to increase, energy management remains a high priority for the RDN. The RDN has not only begun the process of identifying energy consumption and the greenhouse gas emissions (GHGs) that result, but it has also made a commitment to continually monitor and manage energy consumption to meet a realistic energy and emissions reduction quantity.

The RDN has developed a number of management plans for its corporate operations that contribute to the overall sustainability of the region. This climate change plan also contributes to overall sustainability by embedding energy management practices into the day to day operations of the RDN. These practices assist staff in making sound decisions as they undertake their daily responsibilities.

1.1 Regional Climate Change Initiative

Although this report is specific to the RDN's corporate operations, it is part of a much larger project that involves all member municipalities and electoral areas (the community). When all the components are completed, the RDN will become a leader in the adoption of innovative approaches to achieve regional sustainability. Implementation of the RDN and City of Nanaimo Corporate Plans will provide realistic examples to the remaining three municipalities as to what is practical to achieve.

In addition, a first for regional districts in British Columbia, a single community climate change plan will be developed for all member municipalities and electoral areas. Once the community plan is approved by the Board after region-wide consultation, RDN municipal councils will be asked to adopt the community plan as their own.

1.2 Plan Development Process

The RDN hired Hyla Environmental Services Ltd. to take staff through a planning process which culminated in the development of this plan and the City of Nanaimo's corporate climate change plan in the winter of 2007. RDN and City staff make up the project team while RDN staff are responsible for overall project management. Staff were responsible for several critical components of plan development as follows:

- providing the detail required to complete the energy and emissions analysis and confirm the base year emissions quantity
- assisting with the forecast of energy consumption, costs for consumption, and emissions
- selecting the final reduction initiatives to be used to calculate the overall program goal (e.g., the reduction quantity)
- developing the implementation plan

1.3 Overall Program Goal: The Reduction Quantity

The overall program goal of the Corporate Climate Change Plan 2007 is to identify the potential for emission reductions, or the reduction quantity. This has been carefully developed through the planning process by combining the reductions that are possible in each sector into an overall reduction quantity for the RDN's operations. Since emissions are the result of the combustion of fuel and use of electrical energy, the plan incorporates various types of measures, or reduction initiatives, that reduce energy and emissions through:

- conservation through reduced use;
- technological change;
- switching to less carbon intensive fuel; and,
- offsetting conventional energy with renewable energy.

1.4 Climate Change Plan Structure

This plan presents the results of the planning process in six sections. Section 1 provides the introduction, context, and methodology. Section 2 presents the results of the energy and emissions inventory while section 3 presents

the forecasts of energy consumption, costs for consumption, and emissions. Section 4 presents a summary of the reduction initiatives that RDN staff wish to implement as well as the results of complex calculations that estimate the potential reductions for each reduction initiative. Section 5 presents an implementation matrix for each sector and identifies which division is responsible for each initiative while section 6 reorganizes each reduction initiative into departmental divisions, provides an estimate of the cost savings, and a rough estimate of the cost for further study and/or implementation.

1.5 The Challenge of Climate Change and Clean Air Planning

All Canadian communities are faced with tough challenges in responding to the need to curb GHG emissions and adapt to the environmental changes that will result from climate change. In British Columbia, the impacts of climate change will manifest themselves in a number of ways that will present both new challenges and opportunities to communities.

It is inevitable that there will be costs associated with taking action on climate change. While investments in new technologies to mitigate climate change will result in job creation, these investments may also have negative implications for growth in other sectors of the economy. It is important that the Regional District of Nanaimo understand the implications of climate change and its impact on these sectors of the economy. Although the scope of this report does not identify economic impacts, the reduction measures that will result provide guidance to RDN staff on how to identify the economic implications of reducing GHG emissions, if any.

1.6 Global Climate Change and Greenhouse Gas Emissions

The Earth's climate is a dynamic and complex system that is responsible for altering the earth and its inhabitants over the millennia. In modern times, the rate of global climate change has become an increasingly important issue for all levels of government since its effects impact ecological, economic, and social systems in all corners of the world. Internationally, it is accepted that increasing greenhouse gas emissions from human activities is causing the climate to change and scientists and world leaders have recognized that strategies to address global climate change are required.

The most significant piece of the climate change puzzle is greenhouse gases. Carbon dioxide is a naturally occurring greenhouse gas that, in conjunction with naturally occurring water vapour, methane and nitrous oxide, traps the sun's heat energy as it reflects from the surface of the earth. This phenomenon, known as the 'greenhouse effect', allows life to thrive on the majority of the planet by stabilizing global temperature. Conversely, man-made greenhouse gas emissions have been strongly linked to the rapid and continual increase in the earth's atmospheric temperature. If allowed to continue, profound effects on the earth's ecosystem and its inhabitants are predicted.

The key strategy adopted world wide is to reduce and/or limit greenhouse gas emissions into the earth's atmosphere. A series of conventions and summits have been convened over the last 15 years that have resulted in the development of climate control strategies to reduce greenhouse gas emissions.

The 1992 Earth Summit in Rio de Janeiro, Brazil, was followed by the signing of the United Nations Framework Convention on Climate Change; Canada was among the signatories. In December 1997, Canada and more than 160 other countries met in Kyoto, Japan, and agreed on targets to reduce GHG emissions. The agreement that set out those targets, including the options available to countries to achieve them, is known as the Kyoto Protocol. Canada's target is to reduce its GHG emissions to six percent below 1990 levels in the period 2008 to 2012. This target is comparable to the targets of our major trading partners. The Kyoto Protocol entered into force on February 16, 2005. For more information, visit http://www.climatechange.gc.ca/english/newsroom/2005/kyoto_feb16.asp.

The RDN must play the important role of providing strong leadership to ensure that a federal plan speaks to actions that can be implemented at the local level. This can be accomplished through direct funding to local government to set the example necessary for their community to take action, funds for public education programs that are designed to activate residents, or new policies and legislation designed to achieve real results over time while not compromising local economies.

The Intergovernmental Panel on Climate Change has concluded that the rapid increase in the concentration of greenhouse gas emissions in our atmosphere is expected to increase the earth's temperature, change our climate, alter our environment and endanger our health (Government of Canada, 2002).

√ Greenhouse gas emissions are reduced by reducing energy use. Residents and local businesses reduce energy use, save money, and at the same time, reduce greenhouse gas emissions

√ Reinvesting savings into the local community helps to protect existing jobs and to create new jobs

√ By reducing greenhouse gas emissions, air quality can also be improved as air pollutants are reduced concurrently

√ Emissions from transportation sectors are a significant source of greenhouse gases. By reducing our dependence on automobiles, the quality of life improves as traffic congestion is also improved

1.7 Partners for Climate Protection and links to Kyoto

The Regional District of Nanaimo became a member of the The Federation of Canadian Municipalities (FCM) Partners for Climate Protection (PCP) in November 2002. The FCM has been the voice of Canadian municipalities to the Federal government since 1901. The PCP is an umbrella initiative that fosters municipal participation in greenhouse gas emission reduction initiatives and overall sustainability. Its goal is to assist municipalities with their greenhouse gas management initiatives by providing tools and logistical support.

This Climate Change Plan not only focuses on reducing existing greenhouse gas emissions, but also provides the necessary leadership to influence future greenhouse gas emission reductions through a variety of sustainable mechanisms such as land use and transportation planning, building codes, permitting, education, and continuous monitoring that will allow for effective emissions management.

1.8 Local Benefits of Reducing Greenhouse Gas Emissions

Although the co-benefits of reducing energy use and greenhouse gases are varied and dependent upon the manner in which energy is currently used, a managed approach to implementation of reduction measures will have positive effects on air pollution, job creation, and expenditures on energy.

For local government, reducing operating costs, improving public transit and traffic mobility, enhancing open spaces, improving livability and promoting local economic development are additional co-benefits when implementing greenhouse gas emission action plans. Many of the strategies that reduce greenhouse gas emissions affect other cost and livability factors throughout the community at large. For example, less money spent on electricity and fuel costs translates into more disposable income available to the local economy.

Reducing greenhouse gas emissions has the additional benefit of reducing particulate matter, nitrous oxides, sulphur oxides and volatile organic compounds–all common air contaminants that contribute to the degradation of air quality.

1.9 Regional and Local Context

The Regional District of Nanaimo is located on the central east coast of Vancouver Island, in the Georgia Strait-Puget Sound Basin. It covers an area of approximately 207,000 hectares and includes four incorporated municipalities and seven unincorporated electoral areas (Figure 1.9).

The four municipalities in the region are:

1. City of Nanaimo;
2. City of Parksville;
3. Town of Qualicum Beach; and,
4. District Municipality of Lantzville.

The seven electoral areas in the region are:

A: Cedar, South Wellington and Cassidy;
B: Gabriola, Decourcy and Mudge Islands;
C: Extension, Nanaimo Lakes, East Wellington, and Pleasant Valley;
E: Nanoose Bay;
F: Coombs, Hilliers, Errington;
G: French Creek, San Pareil; and,
H: Bowser, Qualicum Bay.

1.10 Energy and Emissions Inventory and Forecast

In order to implement an effective strategy to reduce greenhouse gas emissions, it is necessary to develop an inventory of the emissions. Without an inventory, local government lacks a starting point from which progress can be measured. Further, they will not be able to forecast future emissions and predict the benefits of proposed reduction measures.

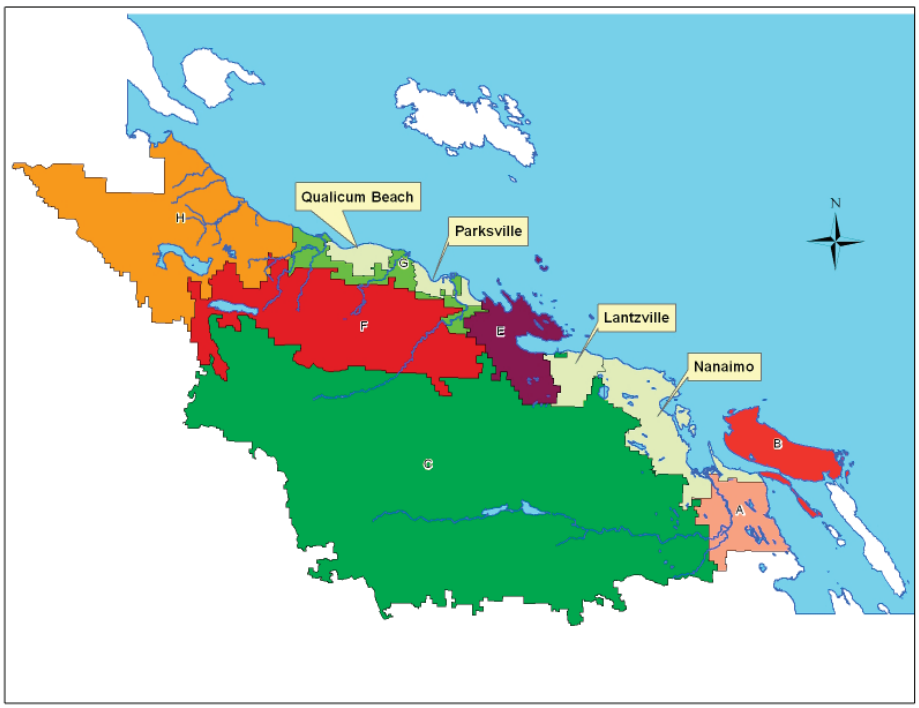


Figure 1.9 Map of the Regional District of Nanaimo.

The emissions inventory for the RDN's operations provides an analysis of all its activities and operations. This report pertains to corporate emissions and related reduction initiatives only. The base year emissions quantity is for 2004 and the project period is from 2007 to 2012.

A review of emissions by sector allows an analysis of the activity or operation responsible for various emissions. Corporate emissions by sector include those resulting from buildings, fleet vehicles and other motorized equipment, street lighting, potable water, storm and sanitary sewers, and solid waste generated at RDN facilities.

A review of emissions by source allows an analysis of the origin of various emissions. The origin of the emission is attributed to the type of fuel burned while carrying out the activity or operation. Major sources of greenhouse gas emissions include electricity, natural gas, diesel fuel, and gasoline. Greenhouse gases are emitted as these fuels are burned. Methane from the decomposition of waste in landfills is also a major source of greenhouse gas emissions, but is a direct emission released into the atmosphere, as opposed to the indirect emissions generated from burning fossil fuels.

The total mass of greenhouse gas emissions is calculated from the energy consumed by the RDN's operations. This information forms the data from which the overall program goal is derived, and upon which the evaluation of progress can be measured in the future.

RDN staff from all sectors of its operations assisted with the collection of energy consumption data.

BC Hydro and Terasen Inc. provided consumption data and costs for consumption of electricity and natural gas for the inventory year of 2004. Vehicle fleet data was compiled from internal RDN records while solid waste generated from operations was derived from the volume of bins at RDN facilities and the frequency of pick-up of the bins.

Milestone One: Complete GHG and energy use inventories and forecasts for both municipal operations and the community as a whole.

Milestone Two: Set Reduction Targets. Suggested PCP targets are a 20 per cent reduction in GHG emissions from municipal operations, and a minimum six per cent reduction for the community, both within 10 years of making the commitment.

Milestone Three: Develop a Local Action Plan. Develop a plan that sets out how emissions and energy use in municipal operations and the community will be reduced.

Milestone Four: Implement the Plan. Create a strong collaboration between the municipal government and community partners to carry through on commitments, and maximize benefits from greenhouse gas reductions.

Milestone Five: Measure Progress. Maintain support by monitoring, verifying, and reporting greenhouse gas reductions.

Energy consumption values are converted to 'equivalent CO_2', or CO_2e, a standardized unit for reporting greenhouse gas emissions.

Calculating emissions from transportation is the most difficult component of an emissions inventory. Only two methods yield reasonable results - gross fuel sales within the municipal boundaries and vehicle kilometres travelled. In each method, the actual number of kilometres travelled within the municipality cannot be accurately calculated.

The data was imported into the Energy and Emissions module of Hyla Environmental Services Ltd.'s Energy & Emissions Sustainability Tool. The emissions calculator within this software conforms to the methods described in the International Panel on Climate Change Greenhouse Gas Inventory Reference Manual (IPCC 2006), the principles provided in the International Standards Organization's (ISO) Draft International Standard for Greenhouse Gases (ISO 2005), and the general guidance within the FCM's guidance document for the preparation of PCP inventories (FCM 2006).

Energy and emissions are calculated at the account level (e.g., an asset that consumes energy, such as a building or pumping facility, represents an account in the software). The exception for RDN data is the vehicle fleet where vehicles are grouped according to departmental division. A detailed summary of the energy and emissions inventory is presented in Appendix A.

The emissions forecast is accomplished using estimates of growth in each sector that were provided by staff and discussed among the project team. Energy costs were estimated from projections by the US Energy Agency.

1.11 Reduction Initiatives and the Reduction Quantity

The Reduction Initiatives module of the Energy & Emissions Sustainability Tool contains 60 initiatives for local government operations, 42 of which were appropriate for presentation to the RDN. Of the 42 reduction initiatives presented to RDN staff, 32 were selected for inclusion in the final compilation of reduction initiatives. Of the 10 reduction initiatives not selected, nine were 'not possible' in the RDN, and one reduction initiative was not selected since it represented a well established program. The reduction initiatives selected are presented in section 4.

The reduction quantity was calculated once staff selected reduction initiatives that could be achieved by the RDN. The calculation of reductions is based on the energy types that are affected by the measure. The total reductions that could be achieved by the RDN is the sum of the individual estimates of each reduction measure, including growth for each sector.

The overall reduction quantity is equal to the difference between the sum of the base year inventory and the reductions, and the forecast year inventory. The overall reduction quantity is expressed as a mass or as a simple percentage of the base year quantity. To achieve a reduction in emissions when the emissions inventory is calculated in 2012, the total reductions achieved during the project period must be greater than the growth in emissions. When expressed as a percentage, the literal translation is, "the emissions inventory in 2012 will be X percent lower than the 2004 base year quantity".

2 Corporate Inventory

2.1 Corporate Inventory Summary

An overview of total energy consumed, costs, and emissions by sector is presented in table 2.1. The RDN's total energy consumed was 118,603 GJ, total costs were $1,655,197, and total greenhouse gas emissions were 5,597 tonnes CO_2e for the 2004 inventory year. A detailed inventory is presented in Appendix A, including a summary for transit buses.

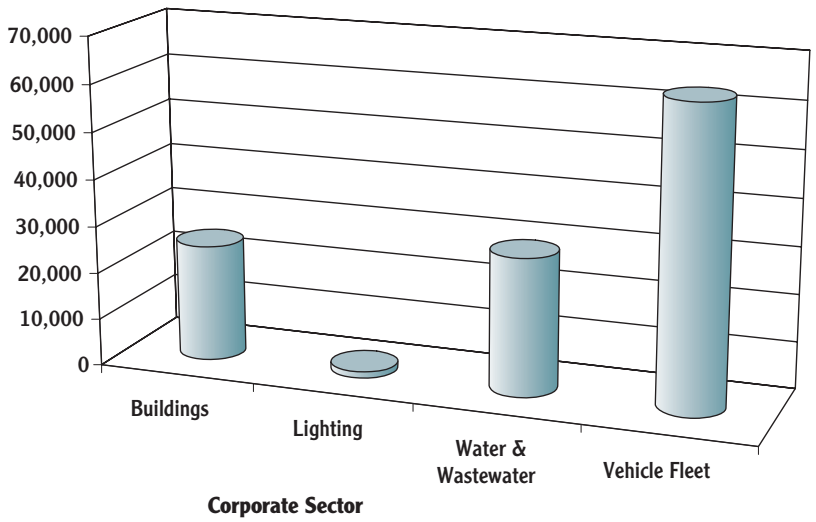
Table 2.1 - Energy, Costs, and Emissions by Sector (2004)

Sector	Total Energy (GJ)	Total Cost	Total Emissions (CO_2e tonnes)	Percent Total Energy by Source	Percent Total Costs by Source	Percent Total Emissions by Source
Buildings	24,742	$319,460	725	21%	19%	13%
Lighting	1,340	$43,172	10	1%	3%	0%
Water & Wastewater	29,131	$426,711	233	25%	26%	4%
Vehicle Fleet	63,390	$865,854	4,559	53%	52%	81%
Solid Waste			70	0%	0%	1%
Total	**118,603**	**$1,655,197**	**5,597**	**100%**	**100%**	**100%**

2.1.1 Corporate Energy Consumption

As figure 2.1.1 illustrates, the majority of energy consumed is in the vehicle fleet sector at 63,390 GJ. Water and wastewater consumed 29,131 GJ, buildings consumed 24,742 GJ, and lighting consumed 1,340 GJ of energy (table 2.1 and figure 2.1.1). Since corporate solid waste is a direct GHG emission to the atmosphere, no energy is purchased and consumed. Sections that follow will discuss the component parts of the inventory as they relate to sector-specific management options.

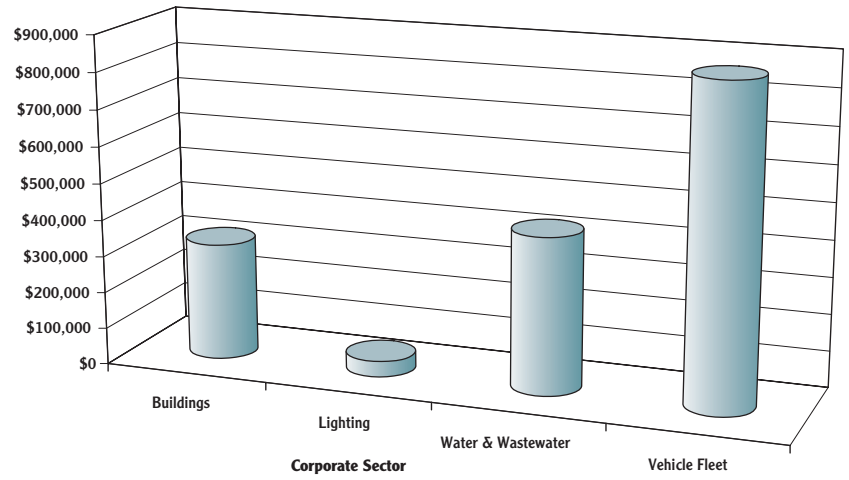
Figure 2.1.1 - 2004 Corporate Energy Consumption (GJ)



2.1.2 Corporate Costs

The majority of the RDN's total energy costs were incurred by the vehicle fleet at $865,854. Water and wastewater costs were $426,711, building costs were $319,460, and lighting costs were $43,172 (table 2.1 and figure 2.1.2). Costs to collect corporate solid waste are insignificant and were not estimated as corporate solid waste is picked up with community waste and data is not tracked. The majority of costs for energy were for diesel fuel for transit buses at $728,942 (not shown).

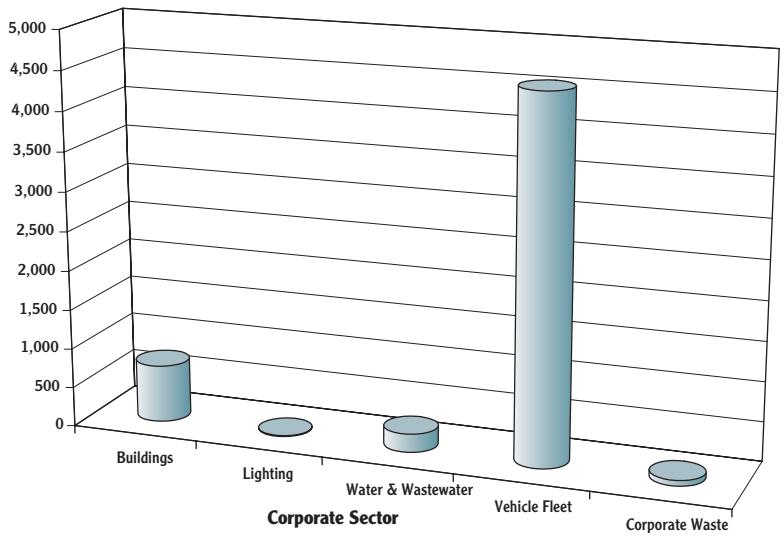
Figure 2.1.2 - 2004 Corporate Energy Costs



2.1.3 Corporate Emissions

The RDN's vehicle fleet produced the majority of emissions at 4,559 tonnes CO_2e or 81 percent of the total. Buildings followed at 725 tonnes or 13 percent, water and wastewater were 233 tonnes or 4 percent, and, lighting and corporate waste made up the remaining 80 tonnes or less than 1 percent of total emissions (table 2.1 and figure 2.1.3). Emissions from diesel fuel for transit buses was 4,085 tonnes CO_2e (not shown).

Figure 2.1.3 - 2004 Corporate Emissions (CO_2e t)



2.1.4 Sources of Corporate Energy and Costs

The RDN consumes only four types of energy: electricity; natural gas; gasoline; and, diesel fuel. In terms of energy content, diesel fuel accounts for nearly half (51 percent) of the total energy consumed by the RDN (table 2.1.4). Electricity (36 percent), natural gas (11 percent), and gasoline (3 percent) follow in rank respectively. Figure 2.1.4a illustrates the mix of energy by source and figure 2.1.4b illustrates costs for energy types.

Table 2.1.4 - Sources of Corporate Energy and Costs (2004)

Energy Type	Units	Total Use	Total Energy (GJ)	Total Cost	Percent Total Energy by Source	Percent Total Costs by Source
Electricity	kWh	11,859,407	42,694	$651,630	36%	39%
Natural Gas	GJ	12,519	12,519	$137,712	11%	8%
Gasoline	litres	86,793	3,008	$65,282	3%	4%
Diesel Fuel	litres	1,561,057	60,382	$800,572	51%	48%
Total			118,603	$1,655,197	**100%**	**100%**

Figure 2.1.4a - 2004 Sources of Corporate Energy (GJ)

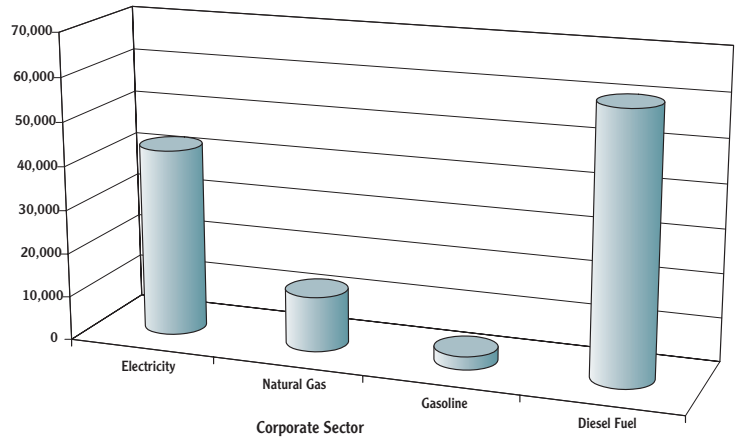
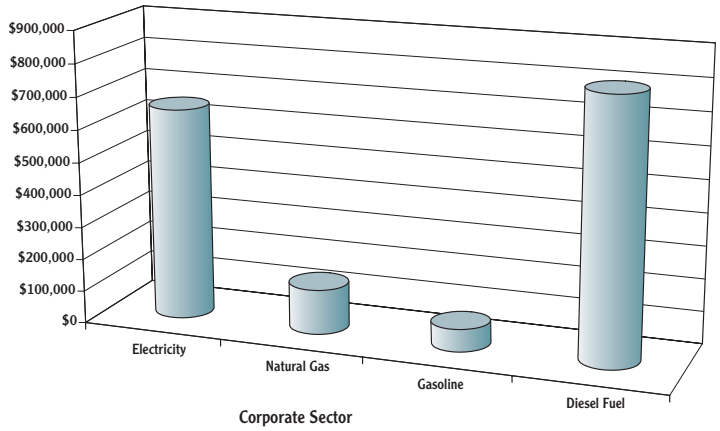


Figure 2.1.4b - 2004 Sources of Corporate Energy Costs



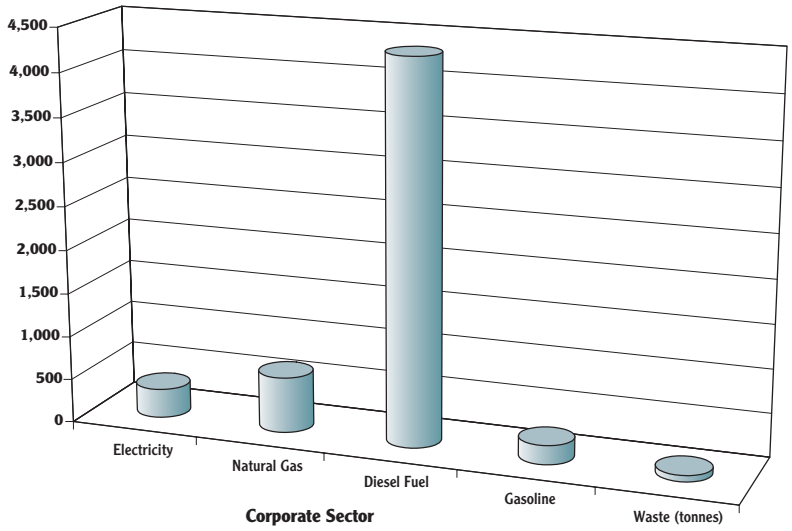
2.1.5 Sources of Corporate Emissions

The greatest source of emissions is from the combustion of diesel fuel (78 percent of total emissions), followed by natural gas (11 percent of total emissions). Figure 2.1.5 illustrates the contribution of energy sources to total emissions. Although diesel fuel is the largest source of corporate emissions, other sectors that are forecast to grow significantly in the future should not be ignored. One such sector is the water and wastewater sector which will grow significantly if the upgrade to the Greater Nanaimo Pollution Control Centre is implemented. In addition, the buildings sector will grow significantly if the proposed addition to the Ravensong Aquatic Centre is implemented.

Table 2.1.5 - Sources of Corporate Emissions (2004)

Energy Type	Units	Total Use	Total Emissions (CO_2e tonnes)	Percent by Source
Electricity	kWh	11,859,407	332	6%
Natural Gas	GJ	12,519	636	11%
Gasoline	litres	86,793	217	4%
Diesel Fuel	litres	1,561,057	4,342	78%
Solid Waste			70	1%
Total			**5,597**	**100%**

Figure 2.1.5 - 2004 Sources of Corporate Emissions (CO_2e t)



The French Creek Pollution Control Centre is the RDN's largest secondary sewage treatment plant and consumes approximately one-fifth of the total energy in the water and wastewater sector.

2.2 Buildings

The RDN owns 15 buildings, the largest of which are the Administration Building, Oceanside Place (an ice arena), and Ravensong Aquatic Centre (an indoor pool). The total energy consumed in all buildings is 24,742 GJ, which is shared equally by two energy types: electricity (12,366 GJ); and, natural gas (12,376 GJ). Total costs for all buildings is $319,460, and their total emissions is 725 tonnes CO_2e (table 2.2.1).

Table 2.2.1 - Summary of Buildings Sector Emissions (2004)

Sector	Energy Type & Units		Total Use	Total Energy (GJ)	Total Costs	Total CO_2e (t)
Buildings	Electricity	kWh	3,434,967	12,366	$183,327	96
	Natural Gas	GJ	12,376	12,376	$136,133	629
Totals				24,742	$319,460	725

2.3 Lighting

Since traffic signals and the majority of streetlights in the region are owned and operated by the RDN's member municipalities, the RDN's share of lighting is not significant. The RDN's lighting consumed 1,340 GJ of electricity (372,344 kWh), resulting in the production of 10 tonnes of CO_2e at a cost of $43,217. Lighting accounted for less than 1 percent of corporate greenhouse gas emissions (table 2.1).

Table 2.3.1 - Summary of Lighting Sector Emissions (2004)

Sector	Energy Type & Units		Total Use	Total Energy (GJ)	Total Costs	Total CO_2e (t)
Lighting	Electricity	kWh	372,344	1,340	$43,172	10
Totals				1,340	$43,172	10

2.4 Water & Wastewater

The RDN operates four pollution control centres (sewage treatment plants), which consume more than half of the total energy consumed in this sector. Overall, 8,052,096 kWh of electricity and 144 GJ of natural gas is consumed, which results in the release of 233 tonnes of emissions at a cost of $426,711 (table 2.4.1).

Table 2.4.1 - Summary of Water and Wastewater Sector Emissions (2004)

Sector	Energy Type & Units		Total Use	Total Energy (GJ)	Total Costs	Total CO_2e (t)
Water & Wastewater	Electricity	kWh	8,052,096	28,988	$425,131	225
	Natural Gas	GJ	144	144	$1,580	7
Totals				29,131	$426,711	233

2.5 Vehicle Fleet

The vehicle fleet includes all motorized vehicles operated by the RDN. The RDN's vehicles produced 4,559 tonnes of CO_2e and fuel costs were $865,854, half of which is paid by the RDN– the other half is paid by BC Transit. Table 2.5.1 provides a summary of emissions by fuel type while table 2.5.2 provides a breakdown of fuel use/type, costs, and emissions by vehicle group.

Table 2.5.1 - Summary of Vehicle Fleet Sector Emissions (2004)

Sector	Energy Type & Units		Total Use	Total Energy (GJ)	Total Costs	Total CO_2e (t)
Vehicle Fleet	Gasoline	litres	86,793	3,008	$65,282	217
	Diesel Fuel	litres	1,561,057	60,382	$800,572	4,342
Totals				63,390	$865,854	4,559

Table 2.5.2 - Corporate Vehicle Fleet Energy, Costs & Emissions (2004)

Account & Address	Account Consumption & Costs by Type					Account Subtotal		
	Type	Consumption	Energy	Costs	CO_2e	Energy	Costs	CO_2e
VEHICLE FLEET								
Diesel Fuel Vehicles								
TRANSIT BUSES TRANSIT BUSES	Diesel Fuel	1,429,298 litres	55,285 GJ	$728,942	3,976 t	**55,285 GJ**	**$728,942**	**3,975.6 t**
SOLID WASTE HEAVY OFF-ROAD EQUIPMENT SOLID WASTE HEAVY OFF-ROAD EQUIPMENT	Diesel Fuel	131,759 litres	5,096 GJ	$71,630	366 t	**5,096 GJ**	**$71,630**	**366.5 t**
Gasoline Vehicles								
TRANSIT SUPPORT VEHICLES TRANSIT SUPPORT VEHICLES	Gasoline	25,262 litres	876 GJ	$15,536	63 t	**876 GJ**	**$15,536**	**63.2 t**
LIQUID WASTE VEHICLES LIQUID WASTE VEHICLES	Gasoline	15,350 litres	532 GJ	$14,429	38 t	**532 GJ**	**$14,429**	**38.4 t**
UTILITIES VEHICLES UTILITIES VEHICLES	Gasoline	14,717 litres	510 GJ	$13,761	37 t	**510 GJ**	**$13,761**	**36.8 t**
BUILDING INSPECTION VEHICLES BUILDING INSPECTION VEHICLES	Gasoline	11,166 litres	387 GJ	$6,867	28 t	**387 GJ**	**$6,867**	**27.9 t**
VEHICLE POOL VEHICLE POOL	Gasoline	8,500 litres	295 GJ	$5,228	21 t	**295 GJ**	**$5,228**	**21.3 t**
RECREATION AND PARKS VEHICLES RECREATION AND PARKS VEHICLES	Gasoline	6,260 litres	217 GJ	$5,853	16 t	**217 GJ**	**$5,853**	**15.7 t**
BYLAW ENFORCEMENT VEHICLES BYLAW ENFORCEMENT VEHICLES	Gasoline	4,388 litres	152 GJ	$2,699	11 t	**152 GJ**	**$2,699**	**11.0 t**
SOLID WASTE SUPPORT VEHICLES SOLID WASTE SUPPORT VEHICLES	Gasoline	1,150 litres	40 GJ	$909	3 t	**40 GJ**	**$909**	**2.9 t**

Buses are included in the inventory since the RDN is responsible for a portion of the costs to operate them and the operation of the buses is a corporate responsibility. The RDN wishes to incorporate the buses into the vehicle fleet and implement reduction measures and monitor and report any reductions in emissions from buses as part of their corporate energy management program.

2.6 Solid Waste

Since the RDN only operates three major corporate facilities, solid waste accounts for less than 1 percent of total corporate emissions and is relatively small compared to other sectors. In 2004, the RDN produced 148 tonnes of municipal waste from its corporate operations which resulted in 70 tonnes of CO_2e.

2.7 Corporate Inventory– Summary

The majority of the RDN's emissions are from the vehicle fleet (80 percent), and specifically transit buses consuming diesel fuel (51 percent). Opportunities exist to reduce fuel consumption and/or emissions from diesel buses, and are further explored in section four. In terms of energy consumed, costs for energy, and total emissions by sector, the vehicle fleet is ranked number one in all categories.

Other than transit buses, a significant amount of energy is consumed in two public buildings: Oceanside Place (340 tonnes) and Ravensong Aquatic Centre (313 tonnes). Other significant energy consumption occurs at four pollution control centres, 21 liquid waste pump stations, and 14 potable water pump stations. Although the highest expenditures for energy are in the vehicle fleet ($865,854 - $728,942 for diesel fuel purchases for transit buses), a significant expenditure for electricity occurs in the water and wastewater sector ($426,711).

The RDN was responsible for the operation of 47 transit buses in 2004; 36 conventional buses and 11 handidarts.

3 Forecasting Energy Consumption & Emissions

The energy and emissions inventory presented in Section 2 provides an important base of information that can be used to compare against future inventories. More importantly, it provides a starting point from which to construct a forecast of energy consumption and emissions. The energy consumption and emissions forecast herein provides insights into future energy consumption and emissions that the RDN may produce. Two types of forecast scenarios have been developed as follows:

1. **Business as Usual (BAU)** – The BAU emissions forecast was developed for the year 2012. This forecast is based on the growth estimates presented in section 3.1 and assumes that no significant GHG reduction measures will be undertaken that would not be considered a common practice (e.g., installing an efficient heating, ventilation, and air conditioning system in a new building would be considered a common practice, whereas the installation of a geothermal heat pump would not);
2. **Typical Implementation** – New initiatives that would not otherwise be considered common practice are implemented according to staff's recommendation to the Board, and the Board's willingness to undertake the initiatives. Mitigation measures will be implemented that reduce energy consumption, costs, and GHG emissions from the business as usual forecast, the effects of which are presented in Section 5– Establishing a Reduction Target.

Forecasts are challenging to develop since they are only as good as one's ability to predict future growth and potential changes in business practices (i.e. public transit expansion). When developing reduction targets (Section 5), it is important that the forecast of emissions is estimated as accurately as possible since it forms part of the calculation of the overall reduction quantity.

The easiest method of developing an emissions forecast is to assume that increases in corporate emissions will be aligned with population growth. In reality, this method is very inaccurate since the addition of one public recreational facility during the forecast period (e.g., indoor pool, ice arena, or new administration hall) would increase corporate emissions by an amount that exceeds the average rate of population growth of 1 percent to 2 percent per year typical in British Columbia (www.bcstats.bc.ca).

The forecast of emissions in the BAU forecast is based on the assumption that the RDN will provide services with the same level of efficiency as it has in the past, but will also make additions and upgrade core services such as public transit, potable water treatment, and sanitary sewage treatment, thereby adding to energy consumed, costs for consumption, and overall emissions.

3.1 Predicted Growth by Sector

The project team developed the growth forecast based on the current capital plan and RDN's plans to meet the future needs of the community. Normally, forecasts are developed 10 years subsequent to the base year inventory. The base year for the corporate inventory is 2004, whereas the base year for the community inventory is 2002. Since the period for the community emissions reduction program will be from 2002 to 2012, the RDN has chosen to shorten the length of the corporate program from 10 years to 8 years so that the overall program is aligned with the community program. The predicted growth in each sector is presented in table 3.1.1.

3.2 Forecast of Energy Consumption and Costs

Energy consumption and associated costs are forecast together although forecasts of each energy type in each sector is weighted according to the mix of energy type in the base year. Although all forecasted parameters are equally important, local governments are paying particular attention to forecasts of energy costs to better prepare for future budgets. Although it is difficult to predict future energy costs, in all certainty, energy costs will increase in the forecast period. Conservative estimates of energy cost increases are provided, but the author makes no claim of expertise in this area and is relying on projections provided by others. Table 3.2.1 and figure 3.2.1 provide a forecast and a chart of projected *energy consumption* to 2012. Table 3.2.2 and figure 3.2.2 provide a forecast and chart of projected *costs for energy* consumption to 2012.

Table 3.1.1 - Forecast by Sector (2004 - 2012)

Sector	Notes	Forecast Percent (2012)
Buildings	proposed 14,500 sq. ft. addition to the Ravensong Aquatic Centre including a four lane, 25–metre pool	26%
Lighting	nominal increase based on 10 year trend	10%
Water and Wastewater[1]	addition of 12 tonnes as the result of new liquid waste pumps and increased volume treated at all pollution control centres	5%
Vehicle Fleet	nominal increase based on 10 year trend for gasoline vehicles. Weighted average for diesel buses includes a 20 percent increase for conventional transit buses and 15 percent increase for handidart buses	20%
Corporate Waste	addition of 6 tonnes from all growth in corporate buildings (e.g., one 5,000 - 10,000 sq. ft. building in the RDN produces ~10 tonnes of emissions)	9%

[1]Although not part of the project period, a significant upgrade to the Greater Nanaimo Pollution Control Centre is planned in 2015 which could increase emissions in the water and wastewater sector by as much as 30 percent. It is imperative that the RDN allow for additional design and construction costs to ensure the upgrade is as energy efficient as possible.

The forecast of energy consumption is aligned with the original growth forecasts in table 3.1.1, whereas the forecast of energy costs is highly dependent upon our prediction of costs per unit of energy in the future. The most difficult cost prediction for energy types is gasoline and diesel fuel. The prediction of $2.50/litre of gasoline and $2.25/litre of diesel fuel is considered conservative and based on a reputable source (Nesbitt Burns Oil & Gas Research - Oil & Gas Weekly). However, predictions from Federal US oil and gas analysts (US Energy Agency) are as high as $4.00/litre and $3.50/litre for gasoline and diesel fuel, respectively.

A major renovation is proposed for Ravensong Aquatic Centre. An additional 14,500 square feet of covered area and a 25–metre pool will double the emissions under the business as usual scenario. Since a significant opportunity exists for geothermal heating at this site, a feasibility study for geothermal heating should be undertaken in the design stages for the planned renovation.

3.3 Forecast of Emissions

The emissions forecast is based on the percentages provided in the initial sectoral forecast (table 3.1.1). For the sake of simplicity, the emissions forecast does not include any predicted changes to electricity emissions factors, either positive or negative (e.g., the emissions factor increases and decreases according to the mix of power generation by hydroelectricity vs. power generation by burning fossil fuels). Instead, the forecast assumes that electricity factors will remain constant over time. The electricity emissions factor is used to convert the amount of electricity consumed to CO_2e and is important in the calculation. Although it is highly unlikely that emissions coefficients will remain constant over the forecast period, the trend in emissions coefficients in British Columbia is not straight forward since they are based on the origin of electricity provided to BC Hydro customers, which in turn is dependent upon overall demand for electrical energy– parameters that are not easily predicted.

Table 3.2.1 - Forecast of Energy Consumption by Sector (2004 - 2012)

Sector	Energy Type/Unit	Consumption	Energy (GJ)	Total Energy (GJ)	Forecast Percent	Forecasted Energy (GJ)	Forecasted Total Energy (GJ)
		2004				2012	
Buildings	Elect (kWh)	3,434,967	12,366	24,742	126%	15,581	31,175
	Nat Gas (GJ)	12,376	12,376			15,594	
Lighting	Elect (kWh)	372,344	1,340	1,340	110%	1,474	1,474
Water & Wastewater	Elect (kWh)	8,052,096	28,988	29,132	105%	30,437	30,589
	Nat Gas (GJ)	144	144			151	
Vehicle Fleet	Diesel (L)	1,561,057	60,382	63,390	120%	72,458	75,767
	Gas (L)	86,793	3,008			3,309	
Total				**118,604**			**139,005**

Figure 3.2.1 - Forecast of Energy Consumption by Sector (2004 - 2012)

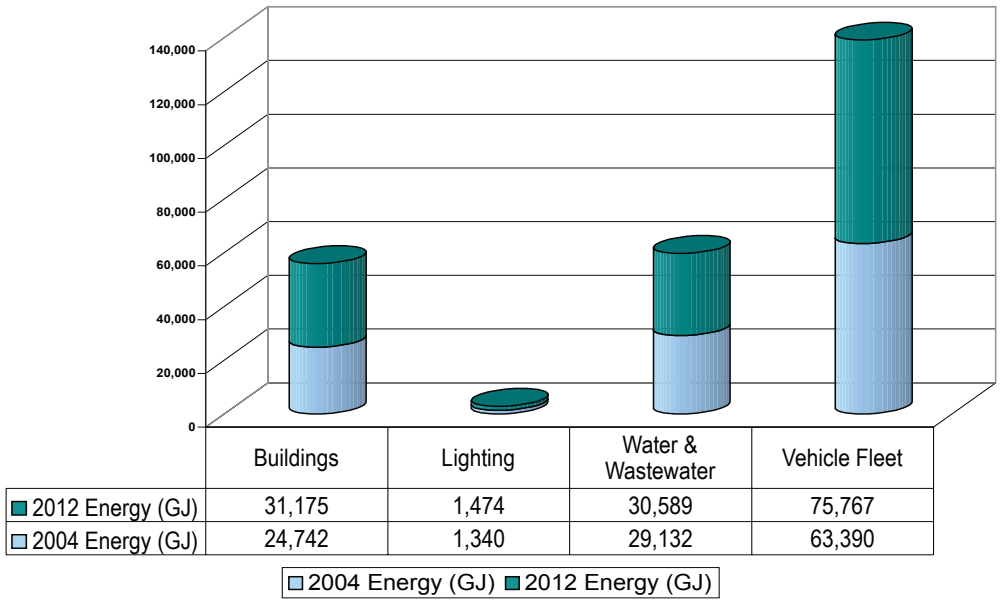


Table 3.2.2 - Forecast of Costs by Sector (2004 - 2012)

Sector	Energy Type/Unit	Consumption	Costs	Total Cost	Forecasted Unit Costs	Forecasted Costs	Forecasted Total Costs
		2004			2012		
Buildings	Elect (kWh)	3,434,967	$183,327	$319,460	$0.06	$259,684	$493,590
	Nat Gas (GJ)	12,376	$136,133		$15.00	$233,906	
Lighting	Elect (kWh)	372,344	$43,172	$43,172	$0.15	$61,437	$61,437
Water & Wastewater	Elect (kWh)	8,052,096	$425,131	$426,711	$0.06	$507,282	$509,550
	Nat Gas (GJ)	144	$1,580		$15.00	$2,268	
Vehicle Fleet	Diesel (L)	1,561,057	$800,572	$865,854	$2.25	$4,214,854	$4,475,233
	Gas (L)	86,793	$65,282		$2.50	$260,379	
Totals				**$1,655,197**			**$5,539,810**

Figure 3.2.2 - Forecast of Costs by Sector (2004 - 2012)

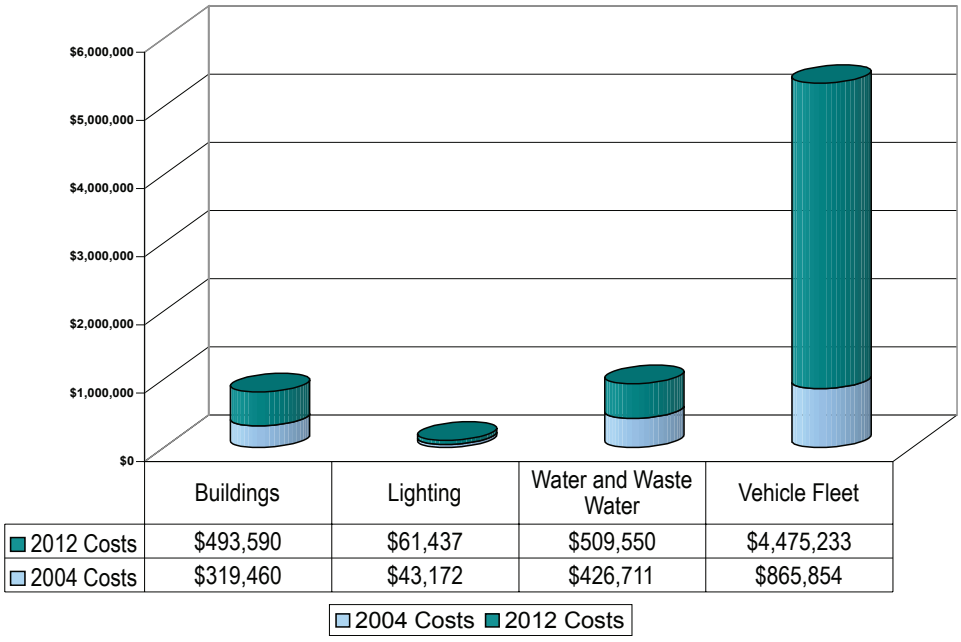
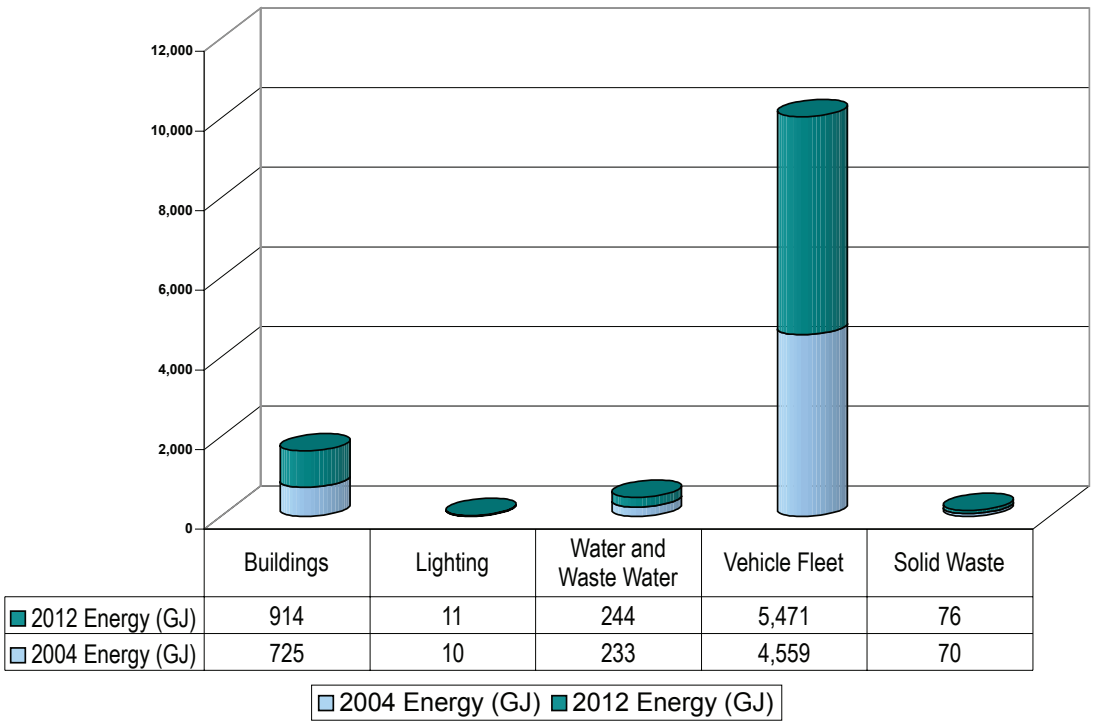


Table 3.3.1 - Forecast of Emissions (CO_2e tonnes) by Sector (2004 - 2012)

Sector	Energy Type/Unit	Emissions CO_2e (t)	Total CO_2e (t)	Forecast Percent	Forecasted Emissions CO_2e (t)
	2004			2012	
Buildings	Elect (kWh)	96	725	126%	914
	Nat Gas (GJ)	629			
Lighting	Elect (kWh)	10	10	110%	11
Water & Waste-water	Elect (kWh)	226	233	105%	244
	Nat Gas (GJ)	7			
Vehicle Fleet	Diesel (L)	4,342	4,559	120%	5,471
	Gas (L)	217			
Corporate Waste	Tonnes	70	70	109%	76
Totals			**5,598**		**6,717**

Figure 3.3.1 - Forecast of Emissions (CO_2e tonnes) by Sector (2004 - 2012)



3.4 Summary of Forecasts

Overall energy consumption is forecast to increase by 17 percent from 2004 to 2012 largely due to the projected 20 percent increase in the vehicle fleet sector. Overall costs for emissions are forecast to increase by 235 percent due to the forecasted increase in the unit cost for automotive fuel. Overall emissions are forecast to increase by 20 percent, lower than the forecast for energy due to the difference in energy types in each of the sectors (electricity and natural gas consumption vary between sectors that are forecast to increase by different amounts). The forecasts for energy consumption, costs, and emissions are summarized in table 3.4.1.

Table 3.4.1 - Summary of Forecasts

Forecasted Parameter	Base Year (2004)	Forecast Year (2012)	Percent Change
Energy Consumption	118,604 GJ	139,005 GJ	17%
Energy Costs	$1,655,197	$5,539,810	235%
Emissions	5,597 tonnes CO_2e	6,717 tonnes CO_2e	20%

Gasoline and diesel fuel are predicted to rise rapidly in the future. The cost of consumption forecast is largely dependent upon the forecasted unit price for fuel, and although the forecast provided is from a reputable source, it is still subjective. Regardless, there is very little doubt that fuel prices will be higher in 2012 than they are today. The forecast for energy costs for other energy types is based on the same assumptions, although unit costs by energy type, especially automotive fuels, are forecast to rise at an accelerated rate in comparison to growth in consumption.

3.5 Forecasts and Their Contribution to Reduction Targets

The forecast of energy consumption, costs and emissions is essentially the growth in these parameters from the base year through to the forecast period. Forecasts allow us to understand future energy consumption, costs of consumption, and emissions. They should be considered a works in progress as new information can change the forecast and therefore the reduction targets.

As stated earlier, the forecast is an essential component of the calculation of the reduction targets. Since all the parameters used to calculate the reduction targets are subject to change, targets are essentially, 'moving' as new information is gathered.

The reduction target is equal to the percent difference between the base year inventory and the forecast year inventory. Since reduction targets are absolute and not based on per capita emissions, to achieve an actual reduction, ***the total reductions achieved during the project period must be greater than the growth in emissions.*** Regardless of any overall increase in emissions during the project period, implementing reduction initiatives will, at a minimum, decrease the amount of growth in emissions if the 'Business as Usual' scenario is allowed to continue.

The reduction initiatives that the RDN selected for implementation over the project period are presented herein. In section 5, an implementation matrix is presented while section 6 organizes the reduction measures according to departmental responsibility.

4 Corporate GHG Reduction Initiatives

For each sector, a table is provided that summarizes estimates of typical reductions for each reduction initiative based on best practices. The estimates do not replace detailed audits of facilities, pumps, etc., which is beyond the scope of this project. Although we have described the reduction amounts as *estimates*, the calculations are based on reductions in the energy type that the measure effects and careful consideration has been given to the affect each measure will have on energy consumption. The emissions resulting from implementation of the reduction initiative are summarized in the table as the *reduction*.

Reduction initiatives reduce emissions from the existing infrastructure (base year emissions) and/or the future infrastructure (growth emissions). The buildings and lighting sectors are the only sectors where some reduction initiatives apply only to the base year emissions, whereas measures in the remaining sectors reduce emissions from only the forecast of emissions (years subsequent to the base year).

4.1 Administrative Considerations

Implementation of reduction initiatives will require a modification to responsibilities with the existing staff establishment. To support implementation, staff must have simple, effective tools to gather and report energy and emissions. Once the process of gathering and reporting energy and emissions becomes routine and is embedded into staff's responsibilities, the RDN should become accustomed to considering reductions of existing energy consumption and growth in energy consumption along with other routine decisions that are made in their day-to-day business.

There are many options available to the RDN to provide the structure and/or support to begin to consider implementation. Options include a senior staff committee or an addition to the scope of an existing committee, assigning responsibility to existing staff, and consulting assistance.

4.2 Number of Measures Implemented

The suggested reduction targets in section 5 are based on all initiatives implemented between 2007 and 2012. Although the actual reductions will depend upon a number of factors, it is likely that measures will be selected based on a combination of life-cycle costs and the actual costs to implement, including real staff costs to administer the project. In the absence of detailed audits, these costs are difficult to estimate, although the project team has carefully considered a typical magnitude of cost for consideration.

4.3 Technology

Technology plays an important role in the actual reductions achieved during the project period. The rate of introduction of new technologies that increase energy efficiency and the availability of alternative energy sources and new technologies for energy production are key to achieving significant reductions in the future. For example, the introduction of new technologies in the automotive industry is accelerating rapidly. Although there are many technologies to consider presently, there is no way to predict what technologies will be available in a two to three year time frame. Staff should keep informed of new technologies and consider closer liaison with higher levels of government and non-government organizations that are able to provide advice to the RDN.

4.4 Reduction Initiatives for the Buildings Sector

Due to the proposed addition to the Ravensong Aquatic Centre, emissions in the buildings sector are forecasted to increase by 15 percent over the 2004 base year emissions quantity (Table 4.4.1). Without implementing the measures listed below, the forecast of emissions is an overall 26 percent increase. Significant reductions are possible for Ravensong Aquatic Centre and Oceanside Place. Pre-feasibility and/or feasibility studies for both facilities should be given high priority given the potential for the two projects may account for as much as 96 percent (283 of 501 tonnes) of an overall 43 percent reduction in buildings sector emissions.

Table 4.4.1 – Estimated Impact of Reduction Initiatives on the Buildings Sector

Buildings Measures	
Measures Affecting Base Year Emissions	**Reduction (CO_2e t)**
Investigate the feasibility of geothermal heating for Ravensong Aquatic Centre	**265.5**
Investigate the feasibility of a heat exchange system on the ice plant for Oceanside Place	**218.3**
Undertake comprehensive building retrofits for all corporate buildings which includes lighting, heating and cooling systems, controls, insulation and windows. Begin with audits of buildings and pumps. Explore opportunities for energy performance contracts with energy service companies. Adopt energy-efficient guidelines for existing buildings (e.g. LEED-EB)	**4.5**
Plant trees and shrubs that provide shade and decrease energy required for cooling (e.g., energy smart landscaping). Investigate vertical vegetative screen for Oceanside Place	**2.4**
Total Reductions from Buildings Measures Affecting Base Year Emissions	***491***
Measures Affecting Growth Emissions	**Reduction (CO_2e t)**
Adopt energy-efficient construction guidelines for new corporate buildings	**8.0**
Adopt a comprehensive energy management policy which includes / supervises corporate building recommendations and guidelines	**1.6**
Monitor corporate energy on a monthly basis and report as necessary. Increase the efficiency of energy consumption data retrieval from energy utilities by receiving energy consumption and cost data in digital form and on a monthly basis. Raise awareness of energy consumption in all corporate infrastructure. Explore all LEED certification programs for new and existing buildings. Investigate all available standards and guidelines available to local government for energy efficiency	**0.2**
Continue to purchase and /or replace older computers, displays, copiers, refrigerators, etc. with models that are Energy Star certified	**0.1**
Total Reductions from Buildings Measures Affecting Growth Emissions	***10***
Total Reductions from Buildings Measures	**501**

4.5 Reduction Initiatives for the Lighting Sector

By implementing a number of new measures designed to improve the energy efficiency of its lighting, the RDN can reduce the GHGs produced in this sector by 77 percent below the 2004 base year emissions quantity (Table 4.5.1). It should be noted that LED ornamental and street lighting are not currently financially practical alternatives, although it is anticipated that the cost for these types of LED lights will decrease significantly during the project period. Liaison with BC Hydro is encouraged. Alternatively, since the City of Nanaimo will be monitoring their own lighting program, close communication with city staff is encouraged.

Table 4.5.1 - Estimated Impact of Reduction Initiatives on the Lighting Sector

Lighting Measures	
Measures Affecting Base Year Emissions	**Reduction (CO_2e t)**
Replace all ornamental lighting with LEDs. Currently, this measure is not cost effective, although it should become cost effective during the project period. Monitor the cost of replacement lighting and implement accordingly (increase liaison with BC Hydro)	**7.2**
Replace all overhead street lighting with LEDs. Currently, this measure is not cost effective. Monitor the cost of replacement lighting and implement accordingly (increase liaison with BC Hydro)	**2.0**
Total Reductions from Lighting Measures Affecting Base Year Emissions	***9***
Measures Affecting Growth Emissions	**Reduction (CO_2e t)**
Adopt energy-efficient lighting policy and include purchase and replacement. Adopt legislative measures for streetlighting requirements in new developments. Consider solar-powered standards for specialized and/or remote applications	**0.1**
Total Reductions from Lighting Measures Affecting Growth Emissions	***0***
Total Reductions from Lighting Measures	**9**

4.6 Reduction Initiatives for the Water & Wastewater Sector

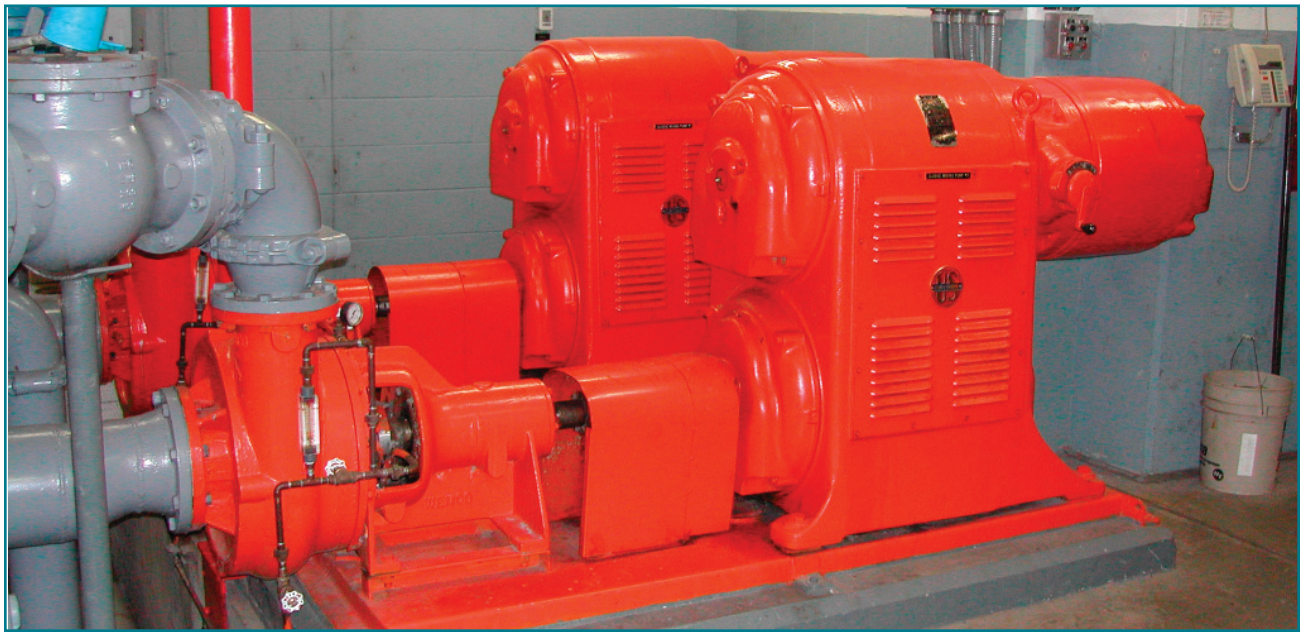
Table 4.6.1 summarizes the potential GHG reductions that could be achieved with the implementation of several initiatives in the water and wastewater sector. With modest reductions in this sector of 30 tonnes, the overall percent reduction from projected emissions is 7 percent.

Of note is an upgrade to the Greater Nanaimo Pollution Control Centre, which is scheduled for 2015. Although construction is planned outside of this plan's project period (2007-2012), it is imperative that the design of the treatment plant incorporates energy efficiency to the highest reasonable standard to reduce the growth of emissions in this sector.

Local governments spend a significant amount of money on energy if they operate potable water and/or sewage treatment facilities

Table 4.6.1. - Estimated Impact of Reduction Initiatives on the Water & Wastewater Sector

Water & Wastewater Measures	
Measures Completed	**Reduction (CO_2e t)**
Reduce potable water consumption (e.g. through installation of water meters, flowbase charges once water meters installed, and introduction of inverted block rate structure for metered sectors)	**6.0**
Implement lawn-watering restrictions	**1.7**
Total Reductions from Water & Wastewater Measures Completed	***8***
Measures Affecting Growth Emissions	**Reduction (CO_2e t)**
Investigate optimization of wastewater treatment motors and pumps	**8.6**
Investigate rebate program on ultra-low-flow toilets (6 lpf)	**5.9**
Consider the use of rain barrels through subsidies, or direct provision to residents	**2.0**
Increase water conservation awareness by enhancing existing 'Team Watersmart' program	**2.0**
Discourage garburetors in new development	**2.0**
Install variable speed pumps on potable water systems	**0.8**
Reduce potable water consumption (e.g. through installation of water meters, flowbase charges once water meters installed, and introduction of inverted block rate structure for metered sectors)	**0.4**
Install low-flow toilets, dual flush toilets, and other water-saving devices in corporate buildings	**0.2**
Total Reductions from Water & Wastewater Measures Affecting Growth Emissions	***22***
Total Reductions from Water & Wastewater Measures	**30**



Motors that drive large pumps consume a significant amount of energy

4.7 Reduction Initiatives for the Vehicle Fleet Sector

There are a number of initiatives in the vehicle fleet sector that the RDN could implement that would further reduce corporate emissions. With potential reductions in this sector of 769 tonnes, the overall percent reduction from projected emissions is minus three percent, which indicates that growth in emissions is expected in this sector. The anticipated growth will be the result of a 20 percent increase in the number of conventional transit buses and a 15 percent increase in the number of handidart buses. Based on growth between 1995 and 2005, a modest increase of 10 percent is expected in the remainder of the corporate fleet. The estimated emission reductions achievable through these initiatives are summarized in Table 4.7.1.

Table 4.7.1. - Estimated Impact of Reduction Initiatives on the Vehicle Fleet Sector

Vehicle Fleet Measures	
Measures Completed	**Reduction (CO_2e t)**
Increase overall fuel efficiency of the conventional bus fleet by replacing older conventional buses with higher fuel efficiency buses	**18.5**
Total Reductions from Vehicle Fleet Measures Completed	***19***
Measures Affecting Growth Emissions	**Reduction (CO_2e t)**
Explore alternatives to both gasoline and diesel fuel including a pilot for biodiesel fuel (e.g., transit buses and heavy trucks and equipment at landfill). Continue to explore other options for alternative fuel transit buses and include greater advocacy with BC Transit (e.g., natural gas and fuel cell technology)	**357.4**
Continue to infill the fleet with higher fuel efficiency buses (both conventional and handidart)	**223.4**
Monitor the fuel efficiency of all corporate vehicles on a unit-by-unit basis (at minimum, monitor conventional and handidart transit buses), report fuel efficiency on a regular basis, and manage the fleet as necessary	**89.4**
Initiate trip reduction measures	**22.6**
Include energy-aware driver training for all staff (improve fuel efficiency and decrease the volume of fuel used)	**22.6**
Examine opportunities to replace corporate vehicles with electric vehicles, hybrid vehicles, flexible fuel vehicles (ethanol blends >E10), and ultra-low emission vehicles. This measure applies to passenger cars and light trucks	**13.5**
Adopt an idle-free policy for staff	**10.3**
Explore a vehicle procurement policy (e.g. fuel efficiency criteria)	**4.1**
Vehicle optimization measures (e.g. choose vehicle based on task)	**4.1**
Implement a nitrogen tire inflation system to improve fuel efficiency	**2.3**
Increase awareness of fuel consumption in all departments and ensure that fuel use, vehicle kilometres traveled, and other indicators for off-road vehicles (hours in operation) are adequately tracked	**0.5**
Total Reductions from Vehicle Fleet Measures Affecting Growth Emissions	***750***
Total Reductions from Vehicle Fleet Measures	**769**

4.8 Reduction Initiatives for the Corporate Solid Waste Sector

Table 4.8.1 summarizes a number of initiatives that RDN staff have recognized for their potential to reduce solid waste produced by the RDNs operations. By reducing the amount of solid waste produced, the RDN could reduce its corporate emissions in this sector by 17 percent below the emissions projection for 2012.

Table 4.8.1 - Estimated Impact of Reduction Initiatives on the Corporate Solid Waste Sector

Solid Waste Measures	
Measures Affecting Growth Emissions	**Reduction (CO_2e t)**
Expand recycling and composting facilities for staff in all RDN buildings	**17.5**
As much as possible, convert to paperless systems (e.g., electronic storage and distribution of digital information)	**0.4**
Total Reductions from Solid Waste Measures Affecting Growth Emissions	***18***
Total Reductions from Solid Waste Measures	**18**

Many opportunities exist to reduce energy consumption and greenhouse gas emissions. Heavy diesel fuel equipment may be able to run biodiesel instead of conventional diesel fuel - thereby reducing greenhouse gas emissions from diesel fuel consumption by approximately 9% (depending upon the blend of biodiesel utilized)

4.9 Summary of Corporate Emission Reductions

If no reduction measures are undertaken, overall emissions will increase by 20 percent, mainly due to the growth of emissions in the vehicle fleet sector. There are many opportunities for new GHG reductions within the RDN's operations. By implementing these initiatives, the RDN could reduce emissions by four percent. Table 4.9.1 provides a summary of the potential reductions in each corporate sector.

Table 4.9.1 – Summary of Estimated Impact of Reduction Measures on the Corporate Sectors

Sector	2004 Base Year Emissions (tonnes CO_2e)	2012 GHG Projection (tonnes CO_2e)	GHG Reductions from Emissions after Projected Growth (2012)	GHG Emissions after Measures (2012)	Percent Reduction From Projected Emissions (2012)
Buildings[1]	725	912	501	411	-43%
Lighting[2]	10	11	9	2	-77%
Water and Wastewater[3]	233	245	30	216	-7%
Vehicle Fleet[4]	4,559	5,471	769	4,702	3%
Corporate Waste	70	76	18	58	-17%
Total	**5,597**	**6,716**	**1,326**	**5,389**	**-4%**

[1]The projection for buildings includes a proposed 25– metre pool and 14,500 sq. ft. expansion to the Ravensong Aquatic Centre.

[2]LEDs for ornamental and overhead lighting are not currently cost effective, although this is expected to change during the project period and should be monitored by staff.

[3]A rough estimate is provided in the water and wastewater sector since the volume of potable water was not available and must be used as an indicator for specific measures.

[4]The reductions for the vehicle fleet may be underestimated given the technological breakthroughs expected in this sector within the next five years.

It is important to remember that the four percent reduction calculated above represents the potential reductions achievable over the project period (2007-2012) relative to the projected emissions in 2012, which includes the growth of emissions during the project period. Although highly unlikely, if no growth in emissions occurred over the project period, the potential reductions of 1,326 tonnes CO_2e would represent a 24 percent reduction from base year emissions.

4.9.1 Corporate Sector Target Statement

Accordingly, an emission reduction target of 1,326 tonnes CO_2e, an amount that will reduce emissions 4 percent below 2004 levels by 2012 is recommended for adoption as the RDN's corporate operations objective.

5 Implementation Matrix for Reduction Measures

A schedule of implementation for reduction measures, or the implementation matrix, is an essential component of this plan. The implementation matrices are presented for each sector and provide a reference to staff for the initiatives that they have selected during the course of the project. Staff decide when to initiate projects and when to recommend that the Board approve the funds that will be required, if any. Section 6 groups projects by departmental divisions and provides an estimate of costs for study and/or implementation as appropriate.

Responsibility: The division responsible for the reduction initiative is indicated in the implementation matrices. In Section 6, reduction initiatives are grouped by Department with the appropriate division indicated.

Implementation Phase: Implementation is divided into two phases spanning several years: 2007 to 2009; and, 2010 to 2012. Most initiatives begin with a feasibility study, or 'Study' (S), although staff may be able to complete feasibility studies for some projects. Actual 'Implementation' (I) will be dependent upon the results of the feasibility studies and/or the wishes of staff and the Board.

5.1 Implementation Matrices and Payback Period

Building retrofits and renewable energy projects must be grouped together for study/implementation. This is important when considering how projects are chosen for implementation. Local governments commonly use a simple payback method (e.g., project costs/energy savings) to evaluate whether or not a project will be implemented.

Generally, projects with short payback periods (e.g., < five years) are favoured over projects with longer payback periods (e.g., > five years) since it is assumed that shorter paybacks are not as risky. An example is the difference between the payback periods of a typical lighting retrofit that could be paid off within three to five years versus implementation of a solar wall, which may take as long as 15-20 years to be paid off.

By choosing projects with *short* payback periods, projects with longer payback periods will usually not be implemented. By blending the projects together, a longer payback period results, but all feasible projects are implemented which results in long–term savings that are far greater than if only short–term payback projects were implemented (the life of the building is always considered in the evaluation). Although the example is simplistic as it does not consider all financial metrics such as return on investment, internal rate of return, life cycle costs, etc., the point is that projects should not be based solely on payback period.

5.2 Implementation in the Buildings Sector

Projects selected for implementation include: building retrofits, renewable energy projects; energy efficient appliances for buildings; energy smart landscaping; energy efficient building construction guidelines; and, an energy management policy. Table 5.2.1 presents the reduction initiatives in the buildings sector.

Table 5.2.1 - Implementation Matrix for Reduction Measures in the Corporate Buildings Sector.

Buildings Measures	Responsibility	2007	2008	2009	2010	2011	2012
Investigate the feasibility of geothermal heating for Ravensong Aquatic Centre	RP	○ S ○ I	◉ S ○ I	○ S ◉ I	○ S ○ I	○ S ○ I	○ S ○ I
Investigate the feasibility of a heat exchange system on the ice plant for Oceanside Place	RP	○ S ○ I	◉ S ○ I	○ S ◉ I	○ S ○ I	○ S ○ I	○ S ○ I
Undertake comprehensive building retrofits for all corporate buildings which includes lighting, heating and cooling systems, controls, insulation and windows. Begin with audits of buildings and pumps. Explore opportunities for energy performance contracts with energy service companies. Adopt energy-efficient guidelines for existing buildings (e.g. LEED-EB)	All	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Plant trees and shrubs that provide shade and decrease energy required for cooling (e.g., energy smart landscaping). Investigate vertical vegetative screen for Oceanside Place	All	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Adopt energy-efficient construction guidelines for new corporate buildings	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Adopt a comprehensive energy management policy which includes / supervises corporate building recommendations and guidelines	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Monitor corporate energy on a monthly basis and report as necessary. Increase the efficiency of energy consumption data retrieval from energy utilities by receiving energy consumption and cost data in digital form and on a monthly basis. Raise awareness of energy consumption in all corporate infrastructure. Explore all LEED certification programs for new and existing buildings. Investigate all available standards and guidelines available to local government for energy efficiency	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Continue to purchase and /or replace older computers, displays, copiers, refrigerators, etc. with models that are Energy Star certified	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I

KEY: All=All Departments; ES=Environmental Services; I=Implement; RP=Recreation and Parks; S=Study; RT=Regional Transportation.

5.3 Implementation in the Lighting Sector

Projects selected for implementation include: replacing ornamental and overhead streetlights with LEDs; and, an energy efficient lighting policy. Table 5.3.1 presents the implementation measures in the lighting sector.

Table 5.3.1 - Implementation Matrix for Reduction Measures in the Lighting Sector.

Lighting Measures	Responsibility	2007	2008	2009	2010	2011	2012
Replace all ornamental lighting with LEDs. Currently, this measure is not cost effective, although it should become cost effective during the project period. Monitor the cost of replacement lighting and implement accordingly (increase liaison with BC Hydro)	ES	◉ S ○ I	◉ S ○ I	◉ S ○ I	○ S ○ I	○ S ○ I	○ S ○ I
Replace all overhead street lighting with LEDs. Currently, this measure is not cost effective. Monitor the cost of replacement lighting and implement accordingly (increase liaison with BC Hydro)	ES	◉ S ○ I	◉ S ○ I	◉ S ○ I	○ S ○ I	○ S ○ I	○ S ○ I
Adopt energy-efficient lighting policy and include purchase and replacement. Adopt legislative measures for streetlighting requirements in new developments. Consider solar-powered standards for specialized and/or remote applications	ES	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I

KEY: All=All Departments; ES=Environmental Services; I=Implement; RP=Recreation and Parks; S=Study; RT=Regional Transportation.

5.4 Implementation in the Water and Wastewater Sector

It should be noted that estimates in this sector are rough as indicators from which to calculate (estimate) reductions were not available. Projects selected for implementation include several initiatives designed to reduce the volume of water consumed and therefore, the volume of potable water pumped to the community and the volume of wastewater pumped through sanitary sewer and treated at the RDN's pollution control centres. Table 5.4.1 presents the implementation measures in the water and wastewater sector.

Table 5.4.1 - Implementation Matrix for Reduction Measures in the Water and Wastewater Sector.

Water & Wastewater Measures	Responsibility	2007	2008	2009	2010	2011	2012
Reduce potable water consumption (e.g. through installation of water meters, flowbase charges once water meters installed, and introduction of inverted block rate structure for metered sectors)	ES	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Implement lawn-watering restrictions		○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Investigate optimization of wastewater treatment motors and pumps	ES	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Investigate rebate program on ultra-low-flow toilets (6 lpf)	ES	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Consider the use of rain barrels through subsidies, or direct provision to residents	ES	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Increase water conservation awareness by enhancing existing 'Team Watersmart' program	ES	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Discourage garburetors in new development	ES	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Install variable speed pumps on potable water systems	ES	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I

KEY: All=All Departments; ES=Environmental Services; I=Implement; RP=Recreation and Parks; S=Study; RT=Regional Transportation.

5.5 Implementation in the Vehicle Fleet Sector

Projects selected for implementation include: vehicle procurement; fuel switches; trip reduction measures; and driver training and increased awareness of fuel consumption. Table 5.5.1 presents the implementation measures in the vehicle fleet sector.

Table 5.5.1 - Implementation Matrix for Reduction Measures in the Vehicle Fleet Sector

Vehicle Fleet Measures	Responsibility	2007	2008	2009	2010	2011	2012
Increase overall fuel efficiency of the conventional bus fleet by replacing older conventional buses with higher fuel efficiency buses	RT	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Explore alternatives to both gasoline and diesel fuel including a pilot for biodiesel fuel (e.g., transit buses and heavy trucks and equipment at landfill). Continue to explore other options for alternative fuel transit buses and include greater advocacy with BC Transit (e.g., natural gas and fuel cell technology)	RT	◉ S ○ I	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Continue to infill the fleet with higher fuel efficiency buses (both conventional and handidart)	RT	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Monitor the fuel efficiency of all corporate vehicles on a unit-by-unit basis (at minimum, monitor conventional and handidart transit buses), report fuel efficiency on a regular basis, and manage the fleet as necessary	RT	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Initiate trip reduction measures	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Include energy-aware driver training for all staff (improve fuel efficiency and decrease the volume of fuel used)	RT	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Examine opportunities to replace corporate vehicles with electric vehicles, hybrid vehicles, flexible fuel vehicles (ethanol blends >E10), and ultra-low emission vehicles. This measure applies to passenger cars and light trucks	RT	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Adopt an idle-free policy for staff	RT	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Explore a vehicle procurement policy (e.g. fuel efficiency criteria)	RT	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Vehicle optimization measures (e.g. choose vehicle based on task)	RT	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Implement a nitrogen tire inflation system to improve fuel efficiency	RT	◉ S ○ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
Increase awareness of fuel consumption in all departments and ensure that fuel use, vehicle kilometres traveled, and other indicators for off-road vehicles (hours in operation) are adequately tracked	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I

KEY: All=All Departments; ES=Environmental Services; I=Implement; RP=Recreation and Parks; S=Study; RT=Regional Transportation.

5.6 Implementation in the Corporate Solid Waste Sector

This sector should not be confused with community solid waste. Projects selected for implementation include expanding recycling and compost facilities at RDN buildings and making an effort to convert to a paperless system where possible (this is usually not possible with legal documents requiring signature). Table 5.6.1 presents the implementation measures in the solid waste sector.

Table 5.6.1 - Implementation Matrix for Reduction Measures in the Corporate Solid Waste Sector

Solid Waste Measures	Responsibility	2007	2008	2009	2010	2011	2012
Expand recycling and composting facilities for staff in all RDN buildings	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I
As much as possible, convert to paperless systems (e.g., electronic storage and distribution of digital information)	All	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I	○ S ◉ I

KEY: All=All Departments; ES=Environmental Services; I=Implement; RP=Recreation and Parks; S=Study; RT=Regional Transportation.

Reducing solid waste from corporate facilities will reduce methane emissions from the landfill.

6 Reduction Initiatives, Costs & Responsibility

Reduction initiatives have been sorted by Departmental Division. Cost savings for energy consumption have been estimated using the average cost per tonne in a particular sector. The costs are rough estimates based on an aggregate of energy mix in a particular sector.

6.1 All Divisions

The initiatives in table 6.1.1 are cross-departmental since they apply mainly to buildings that are shared by several departments.

Table 6.1.1 - Reduction Initiatives for All Divisions

Reduction Initiatives for All Divisions	Reduction (CO_2e t)	Annual Cost Savings for Energy Consumption	Cost Estimate
Initiate trip reduction measures	22.6	$4,282	staff
Expand recycling and composting facilities for staff in all RDN buildings	17.5	N/A	N/A
Adopt energy-efficient construction guidelines for new corporate buildings	8.0	$3,500	$80K
Undertake comprehensive building retrofits for all corporate buildings which includes lighting, heating and cooling systems, controls, insulation and windows. Begin with audits of buildings and pumps. Explore opportunities for energy performance contracts with energy service companies. Adopt energy-efficient guidelines for existing buildings (e.g. LEED-EB)	4.5	conservative estimate$2,000	<$15K
Plant trees and shrubs that provide shade and decrease energy required for cooling (e.g., energy smart landscaping). Investigate vertical vegetative screen for Oceanside Place	2.4	$1,000 per annum as shrubs mature	<$7K
Adopt a comprehensive energy management policy which includes / supervises corporate building recommendations and guidelines	1.6	linked to building retrofits	$80K
Increase awareness of fuel consumption in all departments and ensure that fuel use, vehicle kilometres traveled, and other indicators for off-road vehicles (hours in operation) are adequately tracked	0.5	TBD - tracking increases awareness	$80K
As much as possible, convert to paperless systems (e.g., electronic storage and distribution of digital information)	0.4	N/A	N/A
Continue to purchase and /or replace older computers, displays, copiers, refrigerators, etc. with models that are Energy Star certified	0.1	~$100	as needed

6.2 Recreation and Parks Services

The initiatives for Recreation and Parks Services are the most difficult cost predictions to make. Feasibility studies will need to be completed to arrive at better estimates of cost savings and the cost to implement the measure.

Table 6.2.1 - Reduction Initiatives for Recreation and Parks Services

Reduction Initiatives for Recreation and Parks Services	Reduction (CO_2e t)	Annual Cost Savings for Energy Consumption	Cost Estimate
Investigate the feasibility of geothermal heating for Ravensong Aquatic Centre	265.5	$57,000	Costs for feasibility study approximately $15 -20,000
Investigate the feasibility of a heat exchange system on the ice plant for Oceanside Place	218.3	$47,000	Costs for feasibility study

Oceanside Place is a two-sheet ice arena that was opened in October 2003 in the City of Parksville. Heat exchange on the ice plant should be explored in the immediate future

6.3 Environmental Services

Reduction initiatives falling under Environmental Services include lighting and water and wastewater.

Table 6.3.1 - Reduction Initiatives for Environmental Services

Reduction Initiatives for Environmental Services	Reduction (CO_2e t)	Annual Cost Savings for Energy Consumption	Cost Estimate
Investigate optimization of wastewater treatment motors and pumps	8.6	~$2,500	requires study
Replace all ornamental lighting with LEDs. Currently, this measure is not cost effective, although it should become cost effective during the project period. Monitor the cost of replacement lighting and implement accordingly (increase liaison with BC Hydro)	7.2	$20,000	$900/standard for streetside lighting and $0.5/bulb for seasonal lighting
Investigate rebate program on ultra-low-flow toilets (6 lpf)	5.9	$1,747	required study
Replace all overhead street lighting with LEDs. Currently, this measure is not cost effective. Monitor the cost of replacement lighting and implement accordingly (increase liaison with BC Hydro)	2.0	~$8,300	$2000/standard for lighting that meets IES standards
Consider the use of rain barrels through subsidies, or direct provision to residents	2.0	~$600	depends upon portion paid by RDN
Increase water conservation awareness by enhancing existing 'Team Watersmart' program	2.0	~$600	2 summer students @ $30K
Discourage garburetors in new development	2.0	~$600	staff
Install variable speed pumps on potable water systems	0.8	~$250	requires study
Reduce potable water consumption (e.g. through installation of water meters, flowbase charges once water meters installed, and introduction of inverted block rate structure for metered sectors)	0.4	~$120	requires study
Install low-flow toilets, dual flush toilets, and other water-saving devices in corporate buildings	0.2	$60	~$200/fixture
Adopt energy-efficient lighting policy and include purchase and replacement. Adopt legislative measures for streetlighting requirements in new developments. Consider solar-powered standards for specialized and/or remote applications	0.1	~$300	staff

6.4 Regional Transportation

Given the rising cost of gasoline and diesel fuel, technological changes in the transportation sector are being introduced at a dramatic pace.

Alternative fuel vehicle fleets represent the future's *silver bullet* to reduce emissions and at the same time solve a major component of the climate change mitigation problem. In the past, the cost of alternative fuel vehicles, lack of selection of vehicle types, and lack of acceptance of these vehicles has not allowed them to make a significant mark in the automotive industry– a stereotype that is slowly changing (visit www.fueleconomy.gov).

There is no shortage of new information on alternative fuel vehicles and alternative fuels. The most comprehensive data comes from case studies in the US, although new cases are constantly being posted as new information is tabulated.

- See the Hybrid Experience Report to download the hybrid savings calculator (http://www.hybridexperience.ca/Hybrid_Savings_Calculator.htm)
- See Natural Resources Canada's Alternative Fuel Vehicle Guide for information on alternative fuel vehicles and to conduct a life–cycle cost comparison (http://oee.nrcan.gc.ca/transportation/tools/afvguide/index.cfm?attr=8).
- For biodiesel projects and other alternative fuels projects, see the BC Sustainable Energy Association website (http://www.bcsea.org/sustainableenergy/biodiesel.asp).

The recent addition of five Nova buses will increase overall fuel efficiency of the bus fleet

Table 6.4.1 Reduction Initiatives for Regional Transportation

Reduction Initiatives for Regional Transportation	Reduction (CO_2e t)	Annual Cost Savings for Energy Consumption	Cost Estimate
Explore alternatives to both gasoline and diesel fuel including a pilot for biodiesel fuel (e.g., transit buses and heavy trucks and equipment at landfill). Continue to explore other options for alternative fuel transit buses and include greater advocacy with BC Transit (e.g., natural gas and fuel cell technology)	357.4	Cost savings based on volume of fuel saved	depends upon costs per litre for biodiesel
Continue to infill the fleet with higher fuel efficiency buses (both conventional and handidart)	223.4	Cost savings based on volume of fuel saved	lease costs
Monitor the fuel efficiency of all corporate vehicles on a unit-by-unit basis (at minimum, monitor conventional and handidart transit buses), report fuel efficiency on a regular basis, and manage the fleet as necessary	89.4	Cost savings based on volume of fuel saved	staff plus investigate cost of monitoring software
Include energy-aware driver training for all staff (improve fuel efficiency and decrease the volume of fuel used)	22.6	Cost savings based on volume of fuel saved	staff
Examine opportunities to replace corporate vehicles with electric vehicles, hybrid vehicles, flexible fuel vehicles (ethanol blends >E10), and ultra-low emission vehicles. This measure applies to passenger cars and light trucks	13.5	Cost savings based on volume of fuel saved	require estimated kilometres driven per year
Adopt an idle-free policy for staff	10.3	Cost savings based on volume of fuel saved	staff
Explore a vehicle procurement policy (e.g. fuel efficiency criteria)	4.1	Cost savings based on volume of fuel saved	staff
Vehicle optimization measures (e.g. choose vehicle based on task)	4.1	Cost savings based on volume of fuel saved	staff
Implement a nitrogen tire inflation system to improve fuel efficiency	2.3	Cost savings based on volume of fuel saved	$12K depending upon volume of nitrogen required. Potential to subcontract

7 Conclusions & Recommendations

The Regional District of Nanaimo has calculated its corporate energy consumption, costs for consumption, and emissions for the base year 2004 as shown below.

Forecasted Parameter	Base Year (2004)	Forecast Year (2012)	Percent Change
Energy Consumption	118,604 GJ	139,005 GJ	17%
Energy Costs	$1,655,197	$5,539,810	235%
Emissions	5,597 tonnes CO_2e	6,717 tonnes CO_2e	20%

A forecast of energy consumption, costs for consumption, and emissions was also calculated. The base year and forecast year are also shown below. While energy consumption and emissions are projected to increase by 17 percent and 20 percent respectively, of note is the projection for energy costs– a potential increase of 235 percent.

In consultation with staff, several reduction initiatives have been selected. A summary of the reductions in each sector is presented below along with the overall reduction quantity, expressed as a percentage.

Sector	2004 Base Year Emissions (tonnes CO_2e)	2012 GHG Projection (tonnes CO_2e)	GHG Reductions from Emissions after Projected Growth (2012)	GHG Emissions after Measures (2012)	Percent Reduction From Projected Emissions (2012)
Buildings[1]	725	912	501	411	-43%
Lighting[2]	10	11	9	2	-77%
Water and Wastewater[3]	233	245	30	216	-7%
Vehicle Fleet[4]	4,559	5,471	769	4,702	3%
Corporate Waste	70	76	18	58	-17%
Total	**5,597**	**6,716**	**1,326**	**5,389**	**-4%**

[1]The projection for buildings includes a proposed 25– metre pool and 14,500 sq. ft. expansion to the Ravensong Aquatic Centre.

[2]LEDs for ornamental and overhead lighting are not currently cost effective, although this is expected to change during the project period and should be monitored by staff.

[3]A rough estimate is provided in the water and wastewater sector since the volume of potable water was not available and must be used as an indicator for specific measures.

[4]The reductions for the vehicle fleet may be underestimated given the technological breakthroughs expected in this sector within the next five years.

If implemented, the reduction initiatives presented have the potential to reduce the RDN's corporate emissions in 2012 by 1,326 tonnes CO_2e, or a reduction of 4 percent below the 2004 base year quantity.

In order to achieve this target, it is recommended that the Board approve the emissions reduction quantity for the RDN's operations as follows:

An emissions reduction target of 4 percent below 2004 levels by 2012 is recommended for adoption as the RDN's corporate operations objective.

Further, it is recommended that the RDN consider the following:

1. Ensure that energy and emissions management becomes part of the daily activities of RDN staff so that energy and emissions are continuously monitored and reported as appropriate;
2. Initiate energy efficiency policies and programs beginning with the reduction initiatives identified by the project team and described in section 6 of this report;
3. Minimize growth in energy consumption, costs and emissions by adopting aggressive energy efficient standards for new corporate buildings and additions/renovations of existing buildings;
4. Reduce overall emissions and costs in the vehicle fleet sector by focusing attention on diesel fuel for transit buses– especially if growth in the number of transit buses operating follows the forecasts for population growth in the RDN. Notwithstanding any special emphasis on transit buses, the RDN should begin to infill the corporate operations fleet with hybrid vehicles;
5. Reduce overall emissions and costs in the buildings sector by focusing attention on natural gas consumption at Ravensong Aquatic Centre and Oceanside Place;
6. Assign responsibility for energy and emissions monitoring and reporting within the existing staff establishment and create an interdepartmental managers committee to coordinate and oversee the implementation of reduction initiatives.

References

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IPCC (2006), IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National. Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

Glossary of Terms (IPCC 2006)

Carbon dioxide (CO_2): A naturally occurring gas; also a by-product of burning fossil fuels and biomass, as well as land use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1.

Climate change: A statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines "climate change" as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC thus makes a distinction between "climate change" attributable to human activities altering the atmospheric composition and "climate variability" attributable to natural causes.

Emissions factor: The estimated average emission rate of a given greenhouse gas for a given source.

Equivalent CO_2 (CO_2e): The concentration of CO_2 that would cause the same amount of radiative forcing as a given mixture of CO_2 and other greenhouse gases.

GJ (GigaJoules): A Canadian unit of heating value equivalent to 943,213.3 Btu. The standard gas unit in Canada will be the gigajoule pursuant to GISB under Order 587-A (1997). The Gigajoule is the standard unit of natural gas heating measurement in Canada. A gigajoule (GJ) is a metric term used for measuring energy use. For example, 1 GJ is equal to 277.8 kWh of electricity, 26.9 m^3 of natural gas, 25.9 litres of heating oil. Similar to the energy released when burning a million wooden matches, a gigajoule of gas will cook over 2500 hamburgers, and a gigajoule of electricity will keep a 60-watt bulb continuously lit for six months.

Greenhouse gas: Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This property of greenhouse gases causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides CO_2, N_2O, and CH_4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC): The Kyoto Protocol was adopted at the Third Session of the Conference of the Parties (COP) to the UNFCCC in 1997 in Kyoto, Japan. It contains legally binding commitments in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most Organisation for Economic Co-operation and Development countries and countries with economies in transition) agreed to reduce their anthropogenic greenhouse gas emissions (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The Kyoto Protocol entered into force on February 16, 2005.

Methane (CH_4): An odorless, colorless, flammable gas, CH_4, the major constituent of natural gas, that is used as a fuel and is an important source of hydrogen and a wide variety of organic compounds.

Nitrous Oxide (N_2O): A powerful greenhouse gas with a global warming potential most recently evaluated at 310. Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

United Nations Framework Convention on Climate Change (UNFCC): The Convention was adopted on May 9, 1992, in New York and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the "stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." It contains commitments for all parties. Under the Convention, parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The convention entered into force in March 1994. See: Kyoto Protocol.

Appendix A - Detailed Summary of Emissions Inventory

Regional District Of Nanaimo

Corporate Energy & Greenhouse Gas Emissions Inventory: 2004

Account & Address	Account Consumption & Costs by Type					Account Subtotal		
	Type	Consumption	Energy	Costs	CO_2e	Energy	Costs	CO_2e
2004								
Buildings								
Administration Offices								
RDN Administration Bldg 6300 Hammond Bay Rd	Electricity	336,480 kWh	1,211 GJ	$19,376	9.4 t	**1,842 GJ**	**$26,310**	**41.7 t**
	Natural Gas	630 GJ	630 GJ	$6,934	32.3 t			
Transit Bldg Applecross Rd	Electricity	178,560 kWh	643 GJ	$11,798	5.0 t	**742 GJ**	**$12,892**	**10.1 t**
	Natural Gas	99 GJ	99 GJ	$1,093	5.1 t			
Utilities Office 1065 Herring Gull	Electricity	24,011 kWh	86 GJ	$1,681	0.7 t	**267 GJ**	**$3,666**	**9.9 t**
	Natural Gas	181 GJ	181 GJ	$1,986	9.2 t			
Transit Comfort Station 4286 Departure Bay Rd	Electricity	27,804 kWh	100 GJ	$1,922	0.8 t	**100 GJ**	**$1,922**	**0.8 t**
Utilities Office 2812 Northwest Bay Rd	Electricity	6,608 kWh	24 GJ	$495	0.2 t	**24 GJ**	**$495**	**0.2 t**
Fire Services								
Fire Hall (At Extension) 2201 Bramley Rd	Electricity	25,124 kWh	90 GJ	$1,754	0.7 t	**90 GJ**	**$1,754**	**0.7 t**
Ice Arenas								
Oceanside Place 830 W Island Hwy	Electricity	1,817,280 kWh	6,542 GJ	$88,666	50.9 t	**12,236 GJ**	**$151,293**	**342.2 t**
	Natural Gas	5,693 GJ	5,693 GJ	$62,627	291.3 t			
Indoor Pools								
Ravensong Aquatic Centre 737 Jones Rd	Electricity	682,800 kWh	2,458 GJ	$32,204	19.1 t	**8,230 GJ**	**$95,696**	**314.4 t**
	Natural Gas	5,772 GJ	5,772 GJ	$63,492	295.3 t			
Misc. Bldgs								

Regional District Of Nanaimo

Corporate Energy & Greenhouse Gas Emissions Inventory: 2004

Account & Address	Account Consumption & Costs by Type					Account Subtotal		
	Type	Consumption	Energy	Costs	CO_2e	Energy	Costs	CO_2e
Little Qualicum Hall 1210 Centre Rd	Electricity	7,301 kWh	26 GJ	$641	0.2 t	**26 GJ**	**$641**	**0.2 t**
Campground Office 595 Taylor Bay Rd	Electricity	3,271 kWh	12 GJ	$297	0.1 t	**12 GJ**	**$297**	**0.1 t**
Parks & Sportsfields								
Clubhouse At Community Park 1100 Mcclay Way	Electricity	7,201 kWh	26 GJ	$532	0.2 t	**26 GJ**	**$532**	**0.2 t**
Solid Waste								
Church Rd Transfer Station 860 Church Rd	Electricity	176,160 kWh	634 GJ	$14,166	4.9 t	**634 GJ**	**$14,166**	**4.9 t**
Regionallandfill Office/Maintenance Bldg 1105 Cedar Rd	Electricity	96,840 kWh	349 GJ	$6,565	2.7 t	**349 GJ**	**$6,565**	**2.7 t**
Cedar Rd Landfill Facilities Cedar Rd Weigh Stn	Electricity	24,891 kWh	90 GJ	$1,728	0.7 t	**90 GJ**	**$1,728**	**0.7 t**
Regional Landfill Storage Shed Cedar Rd	Electricity	12,831 kWh	46 GJ	$922	0.4 t	**46 GJ**	**$922**	**0.4 t**
Radio								
Tower Coats Dr	Electricity	7,805 kWh	28 GJ	$580	0.2 t	**28 GJ**	**$580**	**0.2 t**
Buildings Subtotal	Electricity Natural Gas	3,434,967 kWh 12,376 GJ	12,366 GJ 12,376 GJ	$183,327 $136,133	96 t 633 t	**24,742 GJ**	**$319,460**	**729 t**
Lighting								
Ornamental Lighting								
Ornamental Street Ltg French Creek	Electricity	284,124 kWh	1,023 GJ	$17,012	8.0 t	**1,023 GJ**	**$17,012**	**8.0 t**
Overhead Lighting								
Overhead Street Ltg French Creek	Electricity	73,584 kWh	265 GJ	$21,950	2.1 t	**265 GJ**	**$21,950**	**2.1 t**
Overhead Street Ltg Breakwater	Electricity	7,619 kWh	27 GJ	$2,414	0.2 t	**27 GJ**	**$2,414**	**0.2 t**
Overhead Street Ltg General	Electricity	7,018 kWh	25 GJ	$1,796	0.2 t	**25 GJ**	**$1,796**	**0.2 t**
Lighting Subtotal	Electricity	372,344 kWh	1,340 GJ	$43,172	10 t	**1,340 GJ**	**$43,172**	**10 t**

Regional District Of Nanaimo

Corporate Energy & Greenhouse Gas Emissions Inventory: 2004

Account & Address	Account Consumption & Costs by Type					Account Subtotal		
	Type	Consumption	Energy	Costs	CO_2e	Energy	Costs	CO_2e
Water & Wastewater								
Liquid Waste PS								
Departure Bay Ps 2936 Departure Bay Rd	Electricity	2,262,000 kWh	8,143 GJ	$108,643	63.3 t	**8,143 GJ**	**$108,643**	**63.3 t**
Chase River Ps 1174 Island Hwy S.	Electricity	418,320 kWh	1,506 GJ	$23,910	11.7 t	**1,506 GJ**	**$23,910**	**11.7 t**
Wellington Ps Foot Of Entwhistle Dr	Electricity	262,620 kWh	945 GJ	$17,276	7.4 t	**945 GJ**	**$17,276**	**7.4 t**
Bay Ave Ps 385 Bay Ave	Electricity	253,200 kWh	912 GJ	$16,466	7.1 t	**912 GJ**	**$16,466**	**7.1 t**
Lee Road Ps 1045 Lee Rd	Electricity	138,780 kWh	500 GJ	$9,879	3.9 t	**500 GJ**	**$9,879**	**3.9 t**
Lift #6 3270 Schooner Cove Dr	Electricity	105,300 kWh	379 GJ	$7,196	2.9 t	**379 GJ**	**$7,196**	**2.9 t**
Powder Pnt Rd Ph Powder Pt Rd	Electricity	76,365 kWh	275 GJ	$5,282	2.1 t	**275 GJ**	**$5,282**	**2.1 t**
Hall Road Ps 300 Hall Rd	Electricity	59,439 kWh	214 GJ	$4,072	1.7 t	**214 GJ**	**$4,072**	**1.7 t**
Lift #2 2408 Andover Rd	Electricity	21,626 kWh	99 GJ	$1,524	0.7 t	**77 GJ**	**$1,524**	**0.6 t**
Fairwinds Drive Booster Pump Fairwinds Dr	Electricity	12,069 kWh	43 GJ	$875	0.3 t	**43 GJ**	**$875**	**0.3 t**
Duke Point Ps Next To Bc Ferries	Electricity	11,966 kWh	42 GJ	$842	0.3 t	**42 GJ**	**$842**	**0.3 t**
Lift #5 3466 Dolphin Dr	Electricity	6,245 kWh	22 GJ	$477	0.2 t	**22 GJ**	**$477**	**0.2 t**
Lift #4 3541 Collingwood Dr	Electricity	5,573 kWh	20 GJ	$431	0.2 t	**20 GJ**	**$431**	**0.2 t**
Kincade Ps Kincade Rd	Electricity	3,932 kWh	14 GJ	$319	0.1 t	**14 GJ**	**$319**	**0.1 t**
Fairwinds Ps Schooner Cove Dr	Electricity	3,391 kWh	12 GJ	$280	0.1 t	**12 GJ**	**$280**	**0.1 t**
Lift #6 3590 Dolphin Dr	Electricity	2,862 kWh	10 GJ	$245	0.1 t	**10 GJ**	**$245**	**0.1 t**
Lift #1 2325 Andover Rd	Electricity	2,633 kWh	9 GJ	$232	0.1 t	**9 GJ**	**$232**	**0.1 t**
Lift #3 2433 Evanshire Crs	Electricity	2,238 kWh	8 GJ	$425	0.1 t	**8 GJ**	**$204**	**0.1 t**
Lift #7 3332 Rockhampton Rd	Electricity	2,225 kWh	8 GJ	$325	0.1 t	**8 GJ**	**$203**	**0.1 t**

Regional District Of Nanaimo

Corporate Energy & Greenhouse Gas Emissions Inventory: 2004

Account & Address	Account Consumption & Costs by Type					Account Subtotal		
	Type	Consumption	Energy	Costs	CO_2e	Energy	Costs	CO_2e
Columbia Beach Ps 1569 Juan De Fuca Blv	Electricity	793 kWh	3 GJ	$106	0.0 t	**3 GJ**	**$106**	**0.0 t**
Breakwater Ps 991 Dickinson Way	Electricity	511 kWh	2 GJ	$78	0.0 t	**2 GJ**	**$78**	**0.0 t**
Pollution Control Centre								
French Creek Pcc 957 Lee Rd	Electricity Natural Gas	2,104,560 kWh 144 GJ	7,576 GJ 144 GJ	$93,739 $1,580	58.9 t 7.3 t	**7,720 GJ**	**$95,318**	**66.3 t**
Greater Nanaimo Pcc Hammond Bay Rd	Electricity	1,374,000 kWh	4,946 GJ	$67,652	38.5 t	**4,946 GJ**	**$67,652**	**38.5 t**
Nanoose Pcc Nanoose Rd	Electricity	129,300 kWh	465 GJ	$10,033	3.6 t	**465 GJ**	**$10,033**	**3.6 t**
Duke Point Pcc 925 Jackson Rd	Electricity	57,420 kWh	207 GJ	$3,968	1.6 t	**207 GJ**	**$3,968**	**1.6 t**
Potable Water PS								
Nuttall Dr Ps 2548 Nuttall Dr Pump	Electricity	15,162 kWh	55 GJ	$1,096	0.4 t	**66 GJ**	**$2,197**	**1.3 t**
Potable Water Well								
Claudet Rd Well #2 Claudet Rd	Electricity	162,720 kWh	586 GJ	$00,130	4.6 t	**586 GJ**	**$11,351**	**4.6 t**
Nanoose Rd Well Nanoose Rd	Electricity	147,840 kWh	532 GJ	$10,102	4.1 t	**532 GJ**	**$10,102**	**4.1 t**
Plummer Rd Well Plummer Rd	Electricity	111,940 kWh	402 GJ	$7,716	3.1 t	**402 GJ**	**$7,716**	**3.1 t**
Sunrise Road Well Sunrise Rd	Electricity	104,870 kWh	378 GJ	$7,199	2.9 t	**378 GJ**	**$7,199**	**2.9 t**
Sandpiper No 2 Well Yambury Rd1	Electricity	44,969 kWh	162 GJ	$1,013	1.3 t	**162 GJ**	**$3,135**	**1.3 t**
Compton Well Compton Pl	Electricity	30,323 kWh	109 GJ	$2,124	0.8 t	**109 GJ**	**$2,124**	**0.8 t**
Chartwell Blvd Well 775 Chartwell Blv	Electricity	22,328 kWh	80 GJ	$1,578	0.6 t	**80 GJ**	**$1,578**	**0.6 t**
Yambury Road Well Yambury Rd2	Electricity	14,936 kWh	54 GJ	$7,197	0.4 t	**54 GJ**	**$1,071**	**0.4 t**
Surfside Well Island Hwy Lb	Electricity	13,191 kWh	47 GJ	$955	0.4 t	**47 GJ**	**$955**	**0.4 t**
Northwest Bay Rd Well 1285 Northwest Bay Rd	Electricity	13,019 kWh	47 GJ	$909	0.4 t	**47 GJ**	**$909**	**0.4 t**
Claudet Rd Well 1945 Claudet Rd Pump	Electricity	8,821 kWh	32 GJ	$652	0.2 t	**32 GJ**	**$652**	**0.2 t**

Regional District Of Nanaimo

Corporate Energy & Greenhouse Gas Emissions Inventory: 2004

Account & Address	Account Consumption & Costs by Type					Account Subtotal		
	Type	Consumption	Energy	Costs	CO_2e	Energy	Costs	CO_2e
Ballenas Rd Well 1809 Ballenas Rd	Electricity	7,562 kWh	27 GJ	$009	0.2 t	**27 GJ**	**$559**	**0.2 t**
Powder Pnt Rd Well Powder Pt Rd	Electricity	6,639 kWh	24 GJ	$509	0.2 t	**24 GJ**	**$509**	**0.2 t**
Clayton Crs Well Clayton Crs L12	Electricity	4,632 kWh	19 GJ	$365	0.1 t	**16 GJ**	**$365**	**0.1 t**
PRV Station								
Madrona Pt Ps Northwest Bay Rd	Electricity	20,677 kWh	74 GJ	$1,421	0.6 t	**74 GJ**	**$1,421**	**0.6 t**
Rechlorination Station								
Rechlorination Station Fairwinds Dr Pump	Electricity	6,011 kWh	22 GJ	$457	0.2 t	**22 GJ**	**$457**	**0.2 t**
Water & Wastewater Subtotal	Electricity Natural Gas	8,052,096 kWh 144 GJ	28,988 GJ 144 GJ	$425,131 $1,580	225 t 7 t	**29,131 GJ**	**$426,711**	**233 t**
Vehicle Fleet								
Diesel Fuel Vehicles								
Transit Buses Transit Buses	Diesel Fuel	1,429,298 litres	55,285 GJ	$728,942	3,975.6 t	**55,285 GJ**	**$728,942**	**3,975.6 t**
Solid Waste Heavy Off-Road Equipment Solid Waste Heavy Off-Road Equipment	Diesel Fuel	131,759 litres	5,096 GJ	$71,630	366.5 t	**5,096 GJ**	**$71,630**	**366.5 t**
Gasoline Vehicles								
Transit Support Vehicles Transit Support Vehicles	Gasoline	25,262 litres	876 GJ	$15,536	63.2 t	**876 GJ**	**$15,536**	**63.2 t**
Liquid Waste Vehicles Liquid Waste Vehicles	Gasoline	15,350 litres	532 GJ	$14,425	38.4 t	**532 GJ**	**$14,429**	**38.4 t**
Utilities Vehicles Utilities Vehicles	Gasoline	14,717 litres	510 GJ	$13,761	36.8 t	**510 GJ**	**$13,761**	**36.8 t**
Building Inspection Vehicles Building Inspection Vehicles	Gasoline	11,166 litres	387 GJ	$6,867	27.9 t	**387 GJ**	**$6,867**	**27.9 t**
Vehicle Pool Vehicle Pool	Gasoline	8,500 litres	295 GJ	$5,228	21.3 t	**296 GJ**	**$6,227**	**21.3 t**
Recreation And Parks Vehicles Recreation And Parks Vehicles	Gasoline	6,260 litres	217 GJ	$5,853	15.7 t	**217 GJ**	**$5,853**	**15.7 t**
Bylaw Enforcement Vehicles Bylaw Enforcement Vehicles	Gasoline	4,388 litres	152 GJ	$2,699	11.0 t	**152 GJ**	**$2,699**	**11.0 t**

Regional District Of Nanaimo

Corporate Energy & Greenhouse Gas Emissions Inventory: 2004

Account & Address	Account Consumption & Costs by Type					Account Subtotal		
	Type	Consumption	Energy	Costs	CO_2e	Energy	Costs	CO_2e
Solid Waste Support Vehicles Solid Waste Support Vehicles	Gasoline	1,150 litres	40 GJ	$909	2.9 t	**40 GJ**	**$909**	**2.9 t**
Vehicle Fleet Subtotal	Gasoline	86,793 litres	3,008 GJ	$65,282	217 t	**63,390 GJ**	**$865,854**	**4,559 t**
	Diesel Fuel	1,561,057 litres	60,382 GJ	$800,572	4,342 t			
Solid Waste								
Administration Offices								
Rdn Admin Bldg 6300 Hammond Bay Rd	Solid Waste		312 cu. yds	46.80	22.0 t			**22.0 t**
Transit Bldg Applecross Rd	Solid Waste		52 cu. yds	7.80	3.7 t			**3.7 t**
Utilities Office 1065 Herring Gull	Solid Waste		52 cu. yds	7.80	3.7 t			**3.7 t**
Utilities Office 2812 Northwest Bay Rd	Solid Waste		52 cu. yds	7.80	3.7 t			**3.7 t**
Ice Arenas								
Oceanside Place 830 W Island Hwy	Solid Waste		208 cu. yds	31.20	14.7 t			**14.7 t**
Indoor Pools								
Ravensong Aquatic Centre 737 Jones Rd	Solid Waste		312 cu. yds	46.80	22.0 t			**22.0 t**
Solid Waste Subtotal	Solid Waste		988 cu. yds	148.20 t	70 t			**70 t**
Grand Total for Corporate Inventory		Consumption	Energy	Costs	CO_2e	**118,603 GJ**	**$1,655,197**	**5,602 t**
	Electricity	11,859,407 kWh	42,694 GJ	$651,630	332 t			
	Natural Gas	12,519 GJ	12,519 GJ	$137,712	641 t			
	Gasoline	86,793 litres	3,008 GJ	$65,282	217 t			
	Diesel Fuel	1,561,057 litres	60,382 GJ	$800,572	4,342 t			
			Volume	Mass	CO_2e			
	Solid Waste		988 cu. yds	148.20 t	70 t			