Town of Annapolis Royal:
Partners for Climate Protection Milestone 5

Prepared for the Town of Annapolis Royal
By Jacquelyn Maxwell, Municipal Environmental Initiatives Evaluator
April 2012

Clean Annapolis River Project

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Financial support provided by the Town of Annapolis Royal and Nova Scotia Economic and Rural Development and Tourism

Cover photo is from the Town of Annapolis Royal's website: http://www.annapolisroyal.com/

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Acknowledgments

Many individuals and corporate entities played a significant role in the completion of this project. Staff at Town Hall provided data for many of the initiatives as well as for the inventory. In particular Sandi Millet-Campbell, Amery Boyer, and Monica Mills provided information about environmental initiatives that were implemented in the Town. Angelika Waldow, the Town's arborist, and Keith Saunders, the Town's GIS technician, both provided the data necessary to evaluate the Tree Canopy Initiative. Efficiency Nova Scotia provided their support to quantify the impact of the LED Light Exchange Program. The Public Works Department, King's Theatre, Town Hall, and Fire Hall provided the access to their billing records which was necessary to complete this project. Various businesses throughout the Town reported their energy use and Town households responded to the 2012 survey. All of this information was vital to the completion of this project. All staff of Clean Annapolis River Project helped to complete this report.

The necessary financial support for this project was provided by Nova Scotia Economic and Rural Development and Tourism and the Town of Annapolis Royal.

Acronyms

BMP: Better Management Practices

CARP: Clean Annapolis River Project

CO_2e: Equivalent Units of Carbon Dioxide

CTAR: Corporate Town of Annapolis Royal

FCM: Federation of Canadian Municipalities

GHG: Greenhouse Gas

HDPE: High Density Polyethylene

ICI: Institutional, Commercial, and Industrial

ICLEI: International Council for Local Environmental Initiatives

IEAP: International Local Government Greenhouse Gas Emissions Analysis Protocol

IPCC: International Panel on Climate Change

LDPE: Low Density Polyethylene

PCP: Partners for Climate Protection

RSB: Residential and Small Business Sector

UNSM: Union of Nova Scotia Municipalities

Executive Summary

In 2003 the Town of Annapolis Royal joined the 5 Milestone Partners for Climate Protection (PCP) Program. This report accounts for Milestone 5 of the Program. Milestone 5 involves compiling a greenhouse gas (GHG) inventory, comparing this inventory to a baseline GHG emission, and quantifying the impacts of the Town's environmental policies.

Different GHGs trap different amounts of heat per unit released. Because this report quantifies the impacts of methane and nitrogen oxide in addition to carbon dioxide, simply measuring the amount of GHGs released may be misleading. Therefore, all GHGs were converted tonnes of carbon dioxide equivalents (CO_2e).

Environmental initiatives implemented in the Town of Annapolis Royal reduced GHG emissions by 149.8 tonnes CO_2e/year. Initiatives in the Corporate sector accounted for the majority of this reducing GHG emissions by 108.6 tonnes CO_2e/year. The Community sector accounted for a decrease of 41.2 tonnes CO_2e. The replacement of inefficient streetlights with LED streetlights, reductions in solid waste production, and a reduction in plastic bag use were the three initiatives associated with the largest decrease in GHG emissions.

The baseline inventory was compiled by Stephen Hawboldt and calculated GHG emissions in 2006. Where 2006 data was not available 2005 and 2007 data was used. Hawboldt's report found that a total of 12,217.1 tonnes CO_2e were released by the Town in 2006. This report has updated Hawboldt's inventory updated to include GHG emissions for solid waste and transportation. The updated inventory found that 13,100 tonnes CO_2e were emitted by the Town in 2006.

The inventory for the calendar year of 2011 found that a total of 8,500 tonnes CO_2e were emitted from the Town in this time period. While some of this decrease has been attributed to attempts made by the Town to reduce GHG emissions some of this may be due to changes in the methods of data acquisition between the 2006 and 2011 inventory. Data on electricity usage in the earlier report was provided by Nova Scotia Power. Because of metering changes Nova Scotia Power was no long able to provide this data and instead a survey was used to gather information about energy usage in the Town.

Of the 8,500 tonnes CO_2e released 358.0 tonnes were from the Corporate Town of Annapolis Royal. A further 4,404.5 tonnes CO_2e was emitted from the Residential and Small Business sector; 2,902 tonnes CO_2e were emitted from the Industrial, Commercial, and Institutional sector; Transportation accounted for 728 tonnes CO_2e; and Solid Waste was associated with the release of 89 tonnes CO_2e.

1.0 Introduction

In an attempt to combat climate change, over 200 municipalities from the Canadian Federation of Municipalities (FCM) have come together as Partners for Climate Protection (PCP) with the goal of reducing their greenhouse gas (GHG) emissions. The FCM's PCP program consists of Five Milestones to decrease GHG emissions:

- Milestone 1: Create a GHG emissions inventory and forecast;
- Milestone 2: Develop emission reductions targets;
- Milestone 3: Develop a local action plan;
- Milestone 4: Implement the local action plan or set of activities; and
- Milestone 5: Monitor progress and report results.

The Town of Annapolis Royal joined PCP in September 2003 and has completed the first three Milestones of the program. This report will account for Milestone 5. Milestone 1 involved creating an inventory accounting for the Town's GHG emissions for the baseline year 2006. Milestone 5 will consist of creating a GHG inventory of the Town for 2011 and comparing it to the baseline created for Milestone 1. It will also consist of calculating GHG reductions that can be attributed to the Town's policies that were developed in Milestone 3 and implemented in Milestone 4 of the PCP Program.

1.1 Community Profile

At the time of the 2006 census the Town had a population of 444, down 19.3% from 2001 (Statistics Canada 2006). However, the 2011 Census found that the population had increased by 8.5% to 481 people with a total of 323 private dwellings (Statistics Canada 2012). The major types of employment in the community are sales and service occupations (Statistics Canada 2006). Tourism, associated with the Town's historic background, also accounts for a large part of the Town's revenue. Annapolis Royal, along with Port Royal, constitutes the oldest permanent European settlement north of St. Augustine, Florida. Prior to this, the land was inhabited by the Mi'kmaq community (Welcome to Annapolis Royal 2010). The area was colonized by the French in 1605 and was transferred between French and British control numerous times over the subsequent years until Nova Scotia was granted to the British in 1713 (Hawboldt 2008).

The 2006 census shows that the Town has an aging population. The median age of the population was 58.4 with less than 9% of the population under age 15. The median income after tax was $33,456 and the median payment for both rented and owner occupied dwellings was $554 per month. The unemployment rate was at 9%, consistent with the provincial average (Statistics Canada 2006).

The Town has participated in projects related to the environment through numerous initiatives. In addition to achieving Milestones 1 to 3 under the FCM's PCP program, the Town is the location of the only Tidal Power Plant in North America and one of only three in the world (Nova Scotia Power 2011). The Town has also achieved a 65% diversion rate for solid waste and has a 15

hectare wetland established in 2002 functioning as a tertiary waste water system that filters out nitrogen and phosphorus before the water enters the Annapolis River (Ducks Unlimited Canada 2012).

2.0 Annapolis Royal Municipal Environmental Initiatives

Milestone 5 of the FCM's PCP program is to monitor the success of the Town's environmental initiatives and to create a follow-up GHG emission inventory. Monitoring the progress of environmental initiatives allows Municipalities to determine if their measures to reduce greenhouse gases are sufficient and to identify areas where more effective measures are needed.

Since completing PCP Milestones 1-3 the Town has implemented several initiatives in an attempt to decrease the community's GHG emissions and reduce the impact of the Town on the environment. These initiatives consist of:

- The Bicycle Loan Program;
- Brownfield Site Remediation;
- Energy Management for Town Owned Buildings Policy;
- Idling Control Program;
- Invasive Alien Species;
- LED Holiday Light Exchange Program;
- LED Streetlights;
- Reduction in Plastic Bag Use;
- Procurement Policy;
- Reduced Speed Limit;
- Renewable Energy By-Law;
- Tree Canopy Initiative;
- Water Conservation; and
- Zero Waste Enhancements.

2.1 Methodology

To estimate reductions in GHG emissions that result from the Town's policies, various data sets were used. For most estimates decrease of GHG emission reductions the change in energy efficiency or energy consumption that resulted from the initiative was estimated. Where possible, financial records were used to measure this change.

When evaluating GHG reductions carbon dioxide, methane, and nitrogen oxide were taken into consideration. While all three gases contribute to climate change or global warming, some GHGs trap more heat per unit of gas released than others. The potencies of greenhouse gases are measured in terms of their global warming potential.

The failure to account for varying global warming potentials could result in a misleading representation of the impact of the Town's environmental policies. Therefore, greenhouse gases are reported as the equivalent units of carbon dioxide (CO_2e) as determined by the global warming potential of the gas.

Calculations and formulas used to calculate CO_2e emissions are reported in Appendix A. To translate power usage into tonnes of GHGs released, emission intensities from Nova Scotia Power were used (Table 1). Since 2011 emission intensities are not yet published the 2010 value was used.

Table 1 Grams of greenhouse gases released by Nova Scotia Power per kilowatt hour (g/kWh) of energy consumed (Nova Scotia Power 2012).

Year	Nitrous Oxide (NO)	Carbon Dioxide (CO_2)	Carbon Dioxide Equivalents (CO_2e)
2006	2.56	862.63	890.17
2010	1.63	819.65	828.39

A survey of Annapolis Royal residents was conducted in March 2012 and was distributed through the Town's newsletter to residents of Annapolis Royal. The survey received 49 responses and the information from this survey was used to evaluate initiatives and compile the inventory for 2011. These results are subject to an error margin of 12.9% at a 95% confidence level. A copy of the survey is attached in Appendix C.

To fulfill PCP's Milestone 5 reporting requirements, where possible, initiatives are quantified in terms of their GHG emission reductions. In certain cases it is impossible to calculate an initiative's direct impact on GHG emissions. In this situation as much quantitative information as possible is provided about the initiative and a description of the initiative is reported.

2.2 Impacts of Environmental Initiatives

In total it was calculated that 149.8 tonnes CO_2e per year were averted due to the environmental initiatives in the Town. The Community CO_2e reduction accounted for the majority of this. The Community sector GHG emissions are estimated to have decreased by 41.2 tonnes CO_2e, while emissions in the Corporate sector were found to have decreased by 108.6 tonnes CO_2e. Much of this decrease is due to the plastic bag initiative implemented by the Town's retailers. Emissions averted through this initiative were so high because of the large carbon footprint of plastic bags. This carbon footprint was so large because the study that generated it took material extraction, manufacturing, transportation, packaging, use, reuse, and disposal into account. The replacement of streetlights with LED lights also made a sizable decrease to GHGs emitted by the Town.

Table 2 Summary of Corporate and Community Measures and their impacts between 2006 and 2011.

Project Name	Sector	Total Implementation Cost ($)	Savings ($/year)	Energy Reduction per year	CO_2e Reduction (tonnes/year)
Corporate Town of Annapolis Royal Initiatives					
Brownfield Remediation	Buildings	1,000	N/A	N/A	N/A
Energy Management for Town Owned Buildings	Buildings	56,260	6,412	3,572 L furnace oil and 41 205 kWh electricity	38.69
LED Streetlights	Streetlights	200,000	15,506	58,000 kWh/year	46.98
Procurement Policy	Solid Waste	1,000	N/A	0	0
Tree Canopy Initiative	Facilities	58,400	N/A	292 trees planted	1.109
Zero Waste Enhancements	Solid Waste	1,000	1,677	13 tonnes waste to landfill in 2011 compared to 2004/2005	21.84
Corporate Total	-	317,660	23,595	-	108.6
Community Initiatives					
Bicycle Loan Program	Transport	4,000	None for Town	1 015 L of gasoline	2.3
Idling Control Program	Transport	1,500	None for Town	41% of survey respondents indicated a change in behaviour	N/A
Invasive Alien Species Policy	Outreach	1,000	N/A	10 % of survey respondents indicated a change in behaviour	N/A
LED Holiday Lights	Buildings	N/A	None for Town	7,350 kWh	6.09
Plastic Bags	Waste	None for Town	None for Town	1,313,550 plastic bags	31.9
Reduced Speed Limits	Transport	1,000	None for Town	0	0
Renewable Energy By-Law	Buildings	1,000	None for Town	1,680 fewer kWh, partially offset by a rise of 481in furnace oil consumption	0.91
Water Conservation	Water, Outreach	N/A	None for Town	22,662 000 L of water	N/A
Community Total	-	8,500	-	-	41.2

Project Name	Sector	Total Implementation Cost ($)	Savings ($/year)	Energy Reduction per year	CO_2e Reduction (tonnes/year)
Yearly Total	-	-	23,595	-	149.8
Total	-	326,160	89,510	-	303

To calculate the cost of implementation in Table 2 equipment, installation, and communication/promotion costs, and staff time were taken into account. For the Energy Management Policy only renovations for which an energy or cost savings could be estimated were included in the cost. Due to the ongoing nature of the water conservation initiative and the many hours of work put into the initiative the Public Works Department stated that no accurate estimate could be made for the implementation cost of the initiative. Therefore, this implementation cost was omitted.

2.2.1 Bicycle Loan Program

The bicycle loan program was implemented in 2009. This initiative was designed to temporary loan out bicycles at no cost to the residents and visitors of the Town with the aim of reducing car use, and their associated GHG emissions. The Town owned three bicycles for this program which were available to be loaned out. In 2009 the program was used approximately 4.5 times per week on average. The Town estimated that the bicycles were being used for 2.5 hours per day and that the average car burns 9.5 L/100 km. Given these assumptions, if the Bicycle Loan Program was used from May-August, then approximately 2.3 tonnes of CO_2e in each year were averted. However, due to costs associated with the program and administrative logistics the program was abandoned in 2011.

2.2.2 Brownfield Site Remediation

The Town intends to encourage development on sites that are vacant or underutilized due to possible contamination from previous commercial or industrial activities (e.g. hydrocarbon contamination). Developing brownfield sites instead of building on sites with no previous development decreases the amount of land being converted to human use. To date, 12 privately owned, potential brownfield sites have been identified and the Town is handling them on a case-by-case basis, however at this point no action has been taken to remediate these properties. One of the Town's properties was also suspected of being contaminated and an environmental site assessment was conducted on the property. Contamination originating from a Texaco Bulk Plant was found, but is contained.

2.2.3 Energy Management for Town Owned Buildings Policy

The Town's 2008 *Energy Management for Town Owned Buildings Policy* aims at reducing the GHG emissions of Town owned buildings by increasing their energy efficiency and by decreasing energy use. The Town owns four buildings: the Town Hall, the King's Theatre, the Fire Hall, and the

Public Works building. This policy has been responsible for several different retrofits that have decreased the Town's GHG emissions.

Town Hall

Under this policy the inefficient incandescent lights in Town Hall were replaced with more efficient LED lighting in 2010. An independent energy audit conducted by Small Business Lighting Solutions estimated that the total energy usage savings resulting from this project were 17,323 kWh per year. This represents a GHG reduction of 14.35 tonnes of CO_2e every year. The cost savings per year estimated by the auditor was $1,905.50. At this rate the project would pay for itself twice within a single year. To generate these estimates the wattage of the old, inefficient light fixtures and the wattage of newly installed LED light were compared to determine the change in lighting load. The number of hours for which the lights were in use was estimated. The kWh decrease after the LED installation was calculated from these values.

Town Hall has also undergone other renovations increasing the building's energy efficiency. These renovations consist of upgrading an old air exchange, installing new windows, and repointing the bricks. This should reduce the amount of fuel necessary to heat the building. Between 2007 and 2011 furnace oil required to heat the building was reduced by 2,193 L from 7,305 L of furnace oil to 5,111.9 L. This is equivalent to a decrease of approximately 5.878 tonnes CO_2e. The cost per liter of furnace oil was estimated to be $ 0.857/liter. This was estimated by averaging the price per liter of furnace oil in Town Hall's oil bills for the year of 2011. The result of these renovations is approximately $ 1,879 in savings each year.

King's Theatre

To increase the energy efficiency of King's Theatre, the building's first floor windows were replaced in 2008. The new windows are thought to improve insulation and therefore reduce energy loss. However, the energy savings for this retrofit could not be quantified. Unlike the other initiatives to the Town's properties no estimate of energy savings was produced when it was installed. There was only one new upgrade at this time unlike upgrades to other facilities where multiple upgrades occurred simultaneously and since there is also temperature and energy usage variation between years it is not thought that the change in energy usage will be large enough to differentiate changes in energy consumption from normal year to year variation in temperature.

Fire Hall

To reduce energy consumption, LED lights were installed to replace the incandescent lights, a programmable thermostat was installed, motion sensor lighting was installed, and T-12 strip fluorescent lighting was replaced with the more energy efficient T-8 lights. These upgrades were completed in 2011.

When the LED lighting was installed an energy savings estimate was generated by Efficiency Nova Scotia. Efficiency Nova Scotia recorded the energy savings from this project to be 22,288.93

kWh per year. This was based on an estimate of the lighting load before and after the upgrade and an estimate of the number of hours each light is used for in a year. A reduction of 22,288.93 kWh would result in an emissions reduction of 18.463 tonnes CO_2e in a year. Lighting bill savings from this project were estimated to be $2,451.78 per year by Efficiency Nova Scotia which would result in a payback period of less than a year.

The programmable thermostat was installed in September 2011. Between September and December 2011 2,608.6 L of furnace oil was used. The previous year 3,987.6 L were used in the same period. The result is a savings of 1,379 L of furnace oil which is equivalent to a decrease in GHG emissions by 3.70 tonnes CO_2e. However, this could partially be due variations in temperatures between the two years.

An estimate of energy savings was not completed for motions sensors and T-8 lights installed in the Fire Hall. These installations were completed in September 2011. The Fire Hall has received two power bills since then which do demonstrate a reduction in energy consumption; this data could not be extrapolated to infer a yearly energy savings because the amount of energy saved varies strongly by month and not enough data is available at this time. From September to November 2010, 11,880 kWh was consumed while from September to November 2011 7,320 kWh were consumed. The result of this is a 4,560 kWh or 38% decrease in energy consumption since 2010. From November 2010 to January 2011 12,360 kWh was consumed while in the same period in 2011 and 2012 approximately 11,220 kWh was consumed. This is a decrease of 1,140 kWh or a 9% reduction in energy consumption. The strong variation between savings by month makes it impossible to provide an accurate estimate of energy savings based on current data. Furthermore the LED lighting upgrade was completed at the same time. Therefore, reductions due to more efficient lighting could not be distinguished from reductions due to the other upgrades.

Public Works

A new, more energy efficient annex to the Public Works building was opened in November 2011. The energy efficient features of this building include natural lighting, R-50 insulation, a programmable electric thermostat, improved sealing around the windows and doors, energy efficient light bulbs, and a low flow toilet. These renovations were completed too recently to be quantified as the data available at this point is insufficient.

While not all measures to reduce GHG emissions under this initiative could be quantified this policy did result in a significant decrease in energy consumption in the Town of Annapolis Royal. Excluding measures that could not be quantified (i.e. general upgrades to the Fire Hall and King's Theatre) this policy resulted in a reduction of 38.69 tonnes CO_2e each year.

Table 3 The GHG reductions by measure under the Town's Energy Management for Town Owned Buildings Policy

Building	Upgrade	Cost Savings ($/year)	GHG Reduction (tonnes CO_2e/year)
Town Hall	LED light installation	1,905.30	14.350
Town Hall	General Upgrades	1,879.40	5.878
Fire Hall	LED light installation	2,451.78	18.463
Fire Hall	General Upgrades	*	*
Public Works	New Building	*	*
King's Theatre	Upgrade to windows	*	*
Total	-	6,236.48	38.69

* unable to calculate (see details in sections above)

2.2.4 Policy on Idling Control

The Town passed the *Policy on Idling Control* in late 2009. The purpose of this policy was to limit greenhouse gas emissions that harm environmental and human health within the Town. Residents have been informed about this policy and the negative environmental and financial effects of idling through the Town's newsletter and the Town's website. The estimated cost of implementing this project was $1,500.

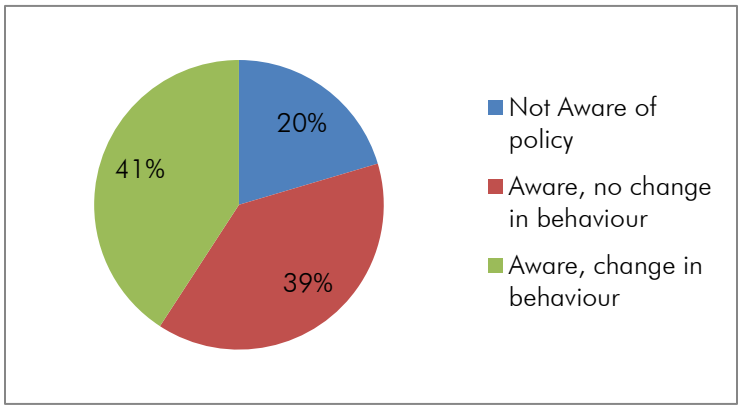

Figure 1 The awareness of the Town's *Policy on Idling Control* in Town households and associated changes in behaviour.

The survey sent to Town residents in March 2012 found that 80% of households were aware of the Town's *Policy on Idling Control* and 41% of households indicated that this initiative had influenced their behaviour or habits.

2.2.5 Invasive Alien Species

In 2011 the *Invasive Alien Species Policy* was implemented. This policy contains four measures to manage invasive alien species in the Town: identification, better management practices (BMP), public outreach and education, and long term management.

The identification aspect of this initiative involves both a public and a private effort to identify areas that have been colonized by invasive alien species.

Better management practices (BMP) were developed by the Clean Annapolis River Project (CARP) to deal with locally problematic species. These practices included proper disposal of invasive

species, not planting invasive species on Town property, and techniques for removing invasive species.

The public outreach and education aspect of this initiative includes collaboration with CARP to build capacity in Town residents to identify common invasive alien species and to inform residents about general best management practices. Public outreach and education material includes a brochure, poster, invasive species factsheets, a plant list, and several flyers. CARP also made presentations to various audiences about invasive species. Outreach and public education was strongest in 2006 and 2007 although presentations to the public about invasive species still occur on a demand basis today. The presentations were made both for out-of-town groups and approximately 6 presentations were made locally for a total audience of approximately 219 people. Presentations types included PowerPoint presentations, guided walks, plant identification, short talks, static displays, and discussions. Signage was posted in natural areas around Town including the French Basin Trail and the Wharf trail in order to reach visitors and promote stewardship. Information about alien invasive species is also occasionally published in the Town's monthly newsletter.

Long Term Management was also included in this policy. Plans for long term management consist of a general mandate for control/eradication of invasive plants along the French Basin Marsh Trail, targeting multiple species, a database of efforts made to control and eradicate invasive alien species, using native plants as ornamentals instead of alien plants, investigate ways in which invasive species are being transported and spread, and pursuing a long-term partnership with community groups to assist in managing invasive plants.

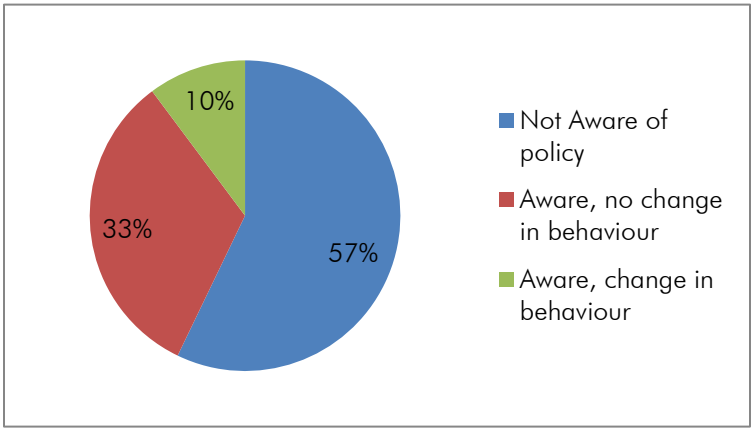

Figure 2 The awareness of the Town's *Invasive Alien Species Policy* in Town households and associated changes in behaviour.

The survey of Town residents found that out of the 49 responses 21 households indicated that they were aware of this policy. Of these 21 households 5 reported that this initiative had resulted in a change in their behaviour or habits.

No reduction of GHG emissions can be calculated from the results of this policy.

2.2.6 LED Holiday Light Exchange Program

The Town acted as a host for LED Holiday Light Exchange Program in 2010 and 2011. This program allows residents to bring their old, inefficient holiday lights to the exchange and receive efficient LED lights in their place. The Town partnered with Nova Scotia Power and Efficiency Nova Scotia to provide this program. This initiative resulted in total energy savings of 7,350 kWh per year which translates into a reduction of 6.09 tonnes of CO_2e per year.

Nova Scotia Power provided the estimate that the average string of incandescent holiday lights uses approximately 175 W of power, while the LED string of lights are 2 W each. Nova Scotia Power also estimated that each string of lights is used on average for approximately 220 hours each holiday season. Therefore, approximately 38 kWh of energy are saved per string. A total of 192 old, inefficient lights were brought in 2011 and another 96 new LED Holiday Lights were given out according to Efficiency Nova Scotia. These values were used to generate the estimate that this initiative resulted in a GHG emissions reduction of 6.09 tonnes of CO_2e per year. This initiative was open to those living beyond the borders of the Town in addition to Town residents. Therefore, some of the reduced energy consumption may have occurred outside of Town limits.

2.2.7 LED Streetlights

In 2009 the Town replaced all of its 139 high pressure sodium and mercury vapour streetlights with LED lights. Annually, $15,506 will be saved per year from this initiative. Electricity data provided by Nova Scotia Power indicated that energy consumption will decrease by 58,000 kWh per year due to this project. This will result in an emissions reduction of 46.98 tonnes CO_2e annually.

2.2.8 Reduction in Plastic Bag Use

In the "Back to the Future: Town of Annapolis Royal" report and submitted to PCP as a part of Milestones 1 and 3, a recommendation was made for the Town to adopt a by-law discouraging plastic bag use. The Town decided that local changes in behaviour as wells as measures implemented by retailers to reduce plastic bag use were sufficient and that a by-law implemented by Town Hall would be redundant. The local Save Easy, for example, began to charge customers for their plastic bag use. Save Easy estimated that following this initiative approximately 50% of patrons brought their own reusable shopping bags. Save Easy has since ceased to charge for plastic bag use, however, Save Easy reported that approximately 50% of their customers still use the reusable shopping bags.

The second food retailer in Town is Foodland. This grocer does not charge for plastic bags. They estimated that approximately 20% of customers currently use reusable shopping bags. They estimate that there has been approximately a 5% increase in reusable bag use since 2011 and that there was a 5% increase in reusable bag use in 2010. These figures are estimated by the grocer.

The managers of these establishments also provided estimates of the number of people who shop at the store each week. Given these numbers it has been calculated that the approximately 740 and 1,350 people who shop at Foodland and Save Easy respectively have switched to reusable bag use. These numbers were used to calculate GHG reductions attributed to this shift to reusable bag use.

Calculations are based on several assumptions. First, the assumption was made that the estimations provided were accurate. Second, it has been assumed that the same people use reusable

bags every week and that customers purchase food from the grocery store once per week. Third, research conduction by the Environment Agency in the UK for emissions related to plastic grocery bag manufacturing was used for these calculations. Fourth, it was assumed that customers are usually loyal to their grocer. Lastly, the calculations do not differentiate between customers who are residents of the Town and those who currently reside outside of the Town limits as this information was not available.

The Environment Agency in the UK found that the average household purchases 446 items from grocery stores over a four week period, which averages out to 111.5 items each week. A single use plastic grocery bag is generally made from high density polyethylene (HDPE). The UK study found that on average HDPE bags could hold 5.88 items per bag. This translates to 19 HDPE bags per week per or 988 bags per year for one household. The UK study attributed a CO_2e value to various uses of HDPE bags which will be used in for the GHG reduction calculations for reusable bag use.

Table 4 CO_2e released by plastic bags for various methods of disposal (Edwards and Fry, 2011)

Usage	CO_2e Emissions (tonnes)
No reuse, no recycling	0.000,025
Recycling with no reuse	0.000,022
Reuse with no recycling	0.000,019
Recycling and reuse	0.000,017

Because the recycling system in Annapolis Royal accepts plastic bags and the UK study found that most people reuse their plastic bags, the "recycling and reuse" estimate of 0.000,017 tonnes CO_2e per plastic bag was used.

Several types of reusable bags were included in the UK study: low density polyethylene (LDPE), non-woven polypropylene, and cotton bags. However, because most plastic bags are made from polyethylene (http://www.packagingknowledge.com/plastic_bags.asp) and reusable cotton bag are less common the assumption was made that people who switched to reusable bags switched from HDPE to LDPE bags.

LDPE bags can hold 7.96 items/bag, more on average than the HDPE bag. Therefore only 15 LDPE bags are required per week, and are reused over the course of the year. For 740 people to use LDPE bags for a year the resulting GHG emissions were calculated to be 1.162 tonnes CO_2e while using HDPE bags for a year results in 12.461 tonnes CO_2e. Therefore, the shift to reusable bag use at Foodland translates into a reduction of the Town's GHG emissions by 11.30 tonnes of CO_2e.

At Save Easy LDPE bag use has lowered GHG emissions for grocery bags by approximately 20.61 tonnes CO_2e. In total, these two local grocery stores have reduced GHG emissions by an estimated 31.91 tonnes CO_2e per year.

2.2.9 Procurement Policy

The third recommendation generated by the "Back to the Future: Town of Annapolis Royal" report in 2009 was that the Town adopt a revised procurement policy. The revised *Procurement Policy* was adopted and came into effect on August 16, 2010. In this policy buying from local sources is included as a factor for consideration. Under the revised policy all procurement requests will indicate that "Energy Star" products will be preferred over other products and include the following statement:

> *All environmental impacts should be considered through the entire procurement process. Environmentally preferable goods and services are those that have a lesser or reduced impact on the environment over the lifecycle of the good or service, when compared with competing goods or services serving the same purpose.*

However, while the Procurement Policy contains these provisions there is no evidence that there has been a measurable shift from the Town to purchase more environmentally friendly or locally produced products. Therefore no CO_2e reduction can be attributed to this policy.

2.2.10 Reduced Speed Limit

The Town attempted to implement a policy to reduce the speed limit on upper St. George Street from 50 km/h to 40 km/h to reduce carbon emissions from vehicles. Many of the small businesses and retailers are situated along this street. After public consultation the reduction of the upper St. George Street speed limit was rejected. Along St. Anthony Street and lower St. George Street the speed limit was reduced from 50 km/h to 40 km/h. However, the most fuel efficient speed, while it varies by car, is generally around 90km/h (Earth Easy). Therefore no energy reductions can be attributed to this policy.

2.2.11 Renewable Energy By-Law

The *By-Law to Permit the Production and Distribution of Energy from Specific Renewable and Green Energy Sources* is a response to recommendations to the Town to adopt guidelines on the installation of renewable energy. This By-Law sets out guidelines and recommendations about the installation and distribution of renewable energy in the Town. The By-Law dictates that the production of renewable energy shall be permitted in all zones of the Town as long as it adheres to the requirements set out in the By-Law. The distribution of renewable energy is also permitted in the By-Law as long as it adheres to the requirements set out in subsection 2(1) of the By-Law as well as municipal, provincial, and federal By-Laws, statutes, and regulations.

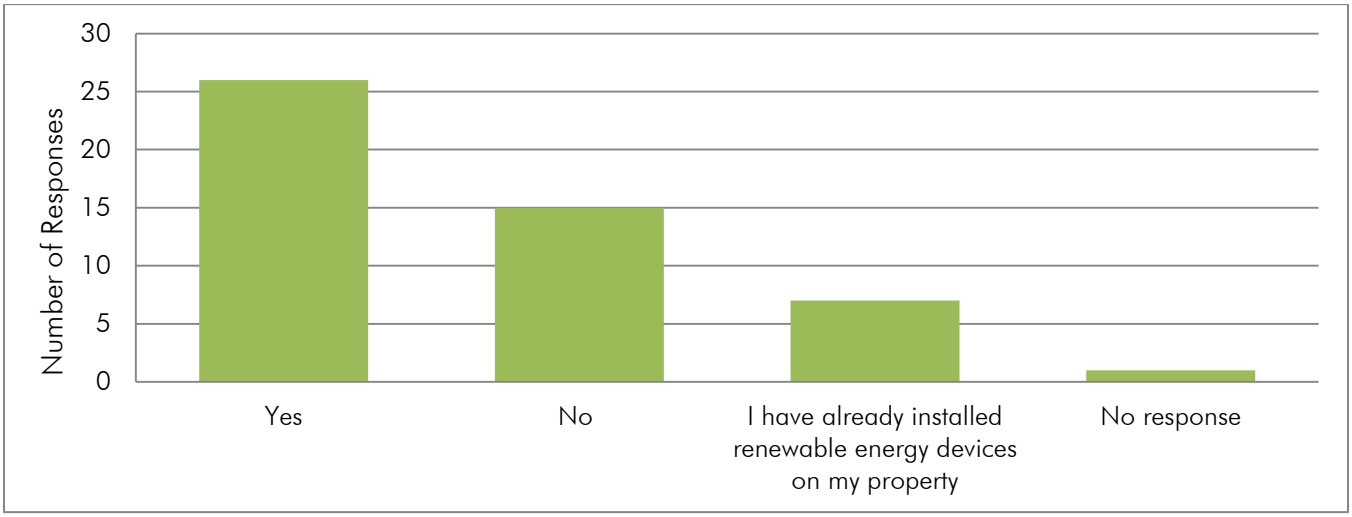

Figure 3 Response to the question "Are you interested in installing renewable energy devices on your property?" on the survey sent out to residents of Annapolis Royal.

The survey of households of Annapolis Royal found that over half were interested in installing renewable energy devices on their property, while several indicated that they already had renewable energy devices installed on their property. Of the 26 households who indicated that they were interested in installing renewable energy devices 23% said that the historical requirements of the Town were one of the main obstacles preventing them from installing renewable energy. The *By-Law to Permit the Production and Distribution of Energy from Specific Renewable and Green Energy Sources* should be of interest to these residents as it clarifies the requirements for installing renewable energy devices such as solar power and geo-thermal energy. However, only 29% of respondents were aware of the existence of this By-Law.

To quantify GHG reductions associated with this initiative the average energy usage for a household in Town was compared to the average energy usage for a house in Town with a renewable energy device. This information was gathered from the 2012 survey. However, only 7 respondents indicated that they had renewable energy devices on their property and of those only 5 provided information about their energy consumption. Therefore, only a small amount of data was available to compile these estimates. It should also be noted that no information was requested on the square footage or number of occupants in the homes, thus differences could be attributed to these variables. On average, homes with renewable energy devices were found to emit 0.13 tonnes CO_2e less per year relative to homes with no renewable energy installed. Currently, there are at least 7 homes with renewable energy devices in the Town of Annapolis Royal. Therefore, this initiative is estimated to have reduced GHG consumption by 0.91 tonnes CO_2e/year.

2.2.12 Tree Canopy

The tree canopy initiative involves planting tree species around the Town. Since 2008, 292 trees have been planted in the Town. This figure includes trees planted by private residents and the Town, however, it does not include shrubs; private trees planted away from the streetscape; or European Ash, Sycamore, or Norway Maple seedlings. Data about the number of trees and the

species type was supplied by the Town arborist, Angelika Waldow. One of the benefits of this tree planting initiative is the sequestration of carbon associated with trees. The carbon sequestration will be counted as a reduction in the Town's GHG emissions.

To calculate the carbon sequestered due to this initiative an estimate of the total biomass of the trees planted was developed (See Appendix A). Total biomass was multiplied by 0.5 which converts the value into total stored carbon (Nowak and Crane 2002). Total stored carbon was found to be 1.211 tonnes. To convert stored carbon into carbon dioxide this value was multiplied by 44.01/12.01. The atomic weight of one molecule of carbon dioxide is 44.01 while the atomic weight of one carbon molecule is 12.01. From this estimate GHG emission reductions were found to be 4.437 tonnes CO_2e between 2008 and 2012. This is approximately 1.109 tonnes CO_2e per year.

2.2.13 Water Conservation

Of the 29 recommendations made in the "Back to the Future: Town of Annapolis Royal" report four related to water usage and water conservation. These recommendations were:

- Adopt a water conservation by-law modeled after the City of Victoria's;
- That the Historic Gardens illustrate the benefits of rain gardens to residents and visitors;
- Construct a rain water holding pond for the Fire Department to use for practice; and
- The separation of sewer and stormwater systems.

Water Conservation Policy

The *Town of Annapolis Royal Water Conservation By-Law* is still under development at the writing of this report, and has yet to be implemented. In its current phase it seeks to limit the amount of water used on lawns during the months of May to September. In its draft, the hours in which residents will be permitted to water their lawns or use a sprinkler will be restricted to 4-10 am and 7-10 pm with sprinkler use prohibited on Monday, Tuesday, and Friday. The By-law would also prohibit "using more water than is required to provide a service, produce a product or complete a task," year round. This prohibition includes over-watering lawns or allowing a tap or hose to run unnecessarily. It is unclear at this time if the by-law will be enforced and by whom.

Historic Gardens

The Historic Gardens partnered with CARP as part of a water conservation project and as a result rain barrels were installed in the Historic Gardens in three locations: at the entry, at Kerr House, and in the Innovative Garden. Together the rain barrels installed on the property have the capacity to collect 1,500 L of rain water. These rain barrels are in use during summer months. The barrels installed in the Innovative Gardens are used to capacity while the other rain barrels are used daily to fill watering cans.

Town Water Systems

Sources of infiltration which allow water to escape from pipes in the Town's drinking water system have been identified by the Department of Public Works. They have prioritized water leakages and worked with property owners to fix the leaks and reduce water waste. This initiative has prevented the unnecessary loss of 22,662,000 L of water. This initiative identified a large water loss at the end of the water utility line near Lequille. The Town is attempting to work with the Historic Gardens to salvage the water collecting at the end of the utility line and put it to use watering the Historic Gardens.

Separation of Stormwater and Sewer Systems

The separation of the storm and sanitary wastewater systems has been an ongoing project for the past 15 years. The goal of this separation was to relieve pressure on the water treatment plant. While there are variations in flow from year to year, flow rates demonstrate a definite downward trend in the volume of water treated each year. Data provided by the engineering firm Hatch Mott MacDonald indicates a reduction of between 14-19% in the average daily flows through the treatment plant since the 2004-2005 baseline. This equates to a reduction of between 40.8 and 55.4 million litres per year going through the treatment system. This has likely contributed to the significant decrease in energy usage by the sewage lines and lift stations observed in section 3.14. No significant decrease in energy usage was observed in the sewage treatment plant between the baseline and 2011. However, data in the "Annapolis Royal Energy Conservation Pilot Project" shows that between 2006 and 2007 there was a dramatic increase in total electricity usage. In 2006 total energy consumption in the CTAR sector was 185,277 kWh, while in 2007 this had increased to 305,169 kWh. The author of "Annapolis Royal Energy Conservation Pilot Project" hypothesized that this was due to the switch from using chlorine to treat waste water to ultraviolet disinfection of its waste water. However, due to metering methods used at the time it could not be determined what facility caused this increase in energy usage. It is possible that this large increase in energy consumption was offset by an increase in stormwater diverted from the sewage treatment plant.

While the sanitary waste water is sent to the sewage treatment plant the stormwater, along with any contaminants it carries, is diverted into a waterway. There was a proposal to create a retention pond in the Town to hold the stormwater. Retentions ponds improve the stormwater quality as sediments and particulates settle out in the pond. Plants, algae, and bacteria in the water may further improve the water quality. The retention pond was to also serve as a source of water for practice for the Volunteer Fire Department. However, as of yet the retention pond has not be constructed.

2.2.14 Zero Waste Enhancements

The Town has been attempting to reduce solid waste in the community to zero after source reduction, reuse, recycling, and composting since 1996. Their initial goal was to achieve zero waste by 2005. While waste is still produced by the community the Town has continued to explore ways to reduce waste. The total amount of garbage generated by the community decreased from 102 tonnes

of waste in 2004/2005 to 89 tonnes of waste in 2011. Per capita waste has decreased in this time from a total of 0.23 tonnes of waste per person from April 2004 to March 2005 to 0.19 tonnes of waste per person in 2011. This is lower than the goal in the *Environmental Goals and Sustainable Prosperity Act* of 300 kg (0.3 tonnes) of solid waste/person/year. The Town also produces less solid waste than the provincial average of 0.401 tonnes/person/year (Olsen, personal communication, March 26, 2012). Since the Town pays $0.129 for each kilogram of waste this equals $1,677 of savings for the Town in 2011. The reduction of solid waste production resulted in a decrease of 21.84 tonnes CO_2e.

Two equations outlined in the International Local Government GHG Emissions Analysis Protocol (IEAP) were combined to form this calculation. The landfill does not use any methane recovery technology. Therefore R, or recovered methane, is equal to 0. Where site specific data was not available default values were used. The calculations for this initiative are reported in Appendix A.

In the same time period there was a modest increase in recycling. In 2005, 48 tonnes of material was recycled while in 2011 the amount of recycled material increased to 49 tonnes. The amount of waste being composted also increased. In 2003 Town residents composted approximately 28 tonnes of compost while the businesses and institutions produced 69 tonnes of compost. This has increased to 57 tons in 2010/2011 for residents and 88 tons for business and institutions.

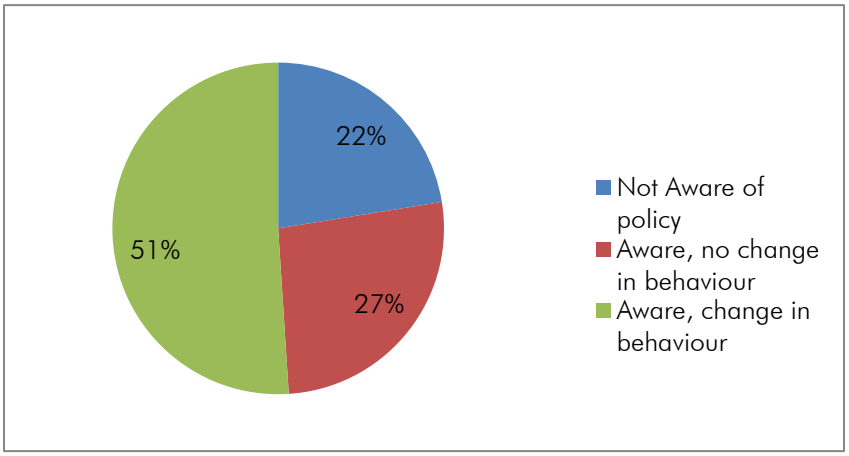

Figure 4 The awareness of the Town's *Zero Waste Initiative* in Town residents and associated changes in behaviour

Of the 49 Town households surveyed a total of 78% were aware of the zero waste initiative. Over half of those surveys indicated that the Zero Waste Initiative had altered their behaviour or habits.

In the 2012 survey 7 out of the 49 households indicated that their method for disposing of their compostable organic waste included the garbage. When asked about barriers to disposing of their compostable organic waste 76% of respondents indicated that they did not face any barriers- they were able to easily dispose of their compostable organic waste. For the remaining respondents the location of the community green bins as well as transportation to the community collection bins were listed as a significant obstacle.

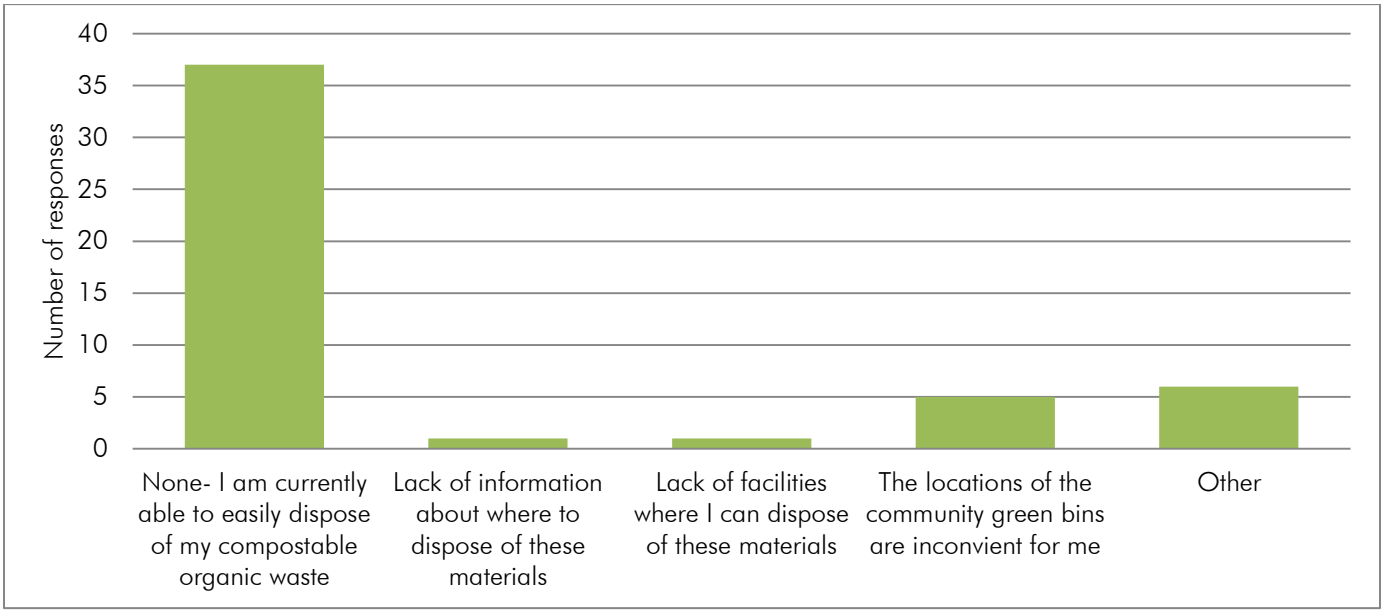

Figure 5 Responses to the 2012 survey question "What is/are the biggest obstacle(s) in disposing of your compostable organic waste?"

Of those who responded "Other" 4 indicated that transportation to the community collection bin was an obstacle. The remaining two "Other" responses said that animals infiltrating their backyard composter and no place to sort out waste in their apartment were significant obstacles to proper disposal or organic waste.

2.3 Town Initiative Conclusions

The Town's environmental initiatives averted the release of approximately 149.8 tonnes CO_2e per year for a total of 303 tonnes CO_2e since 2006. The majority of this was from the Corporate sector where environmental initiatives resulted in a decrease of approximately 108.6 tonnes CO_2e per year. The installation of LED streetlights was the initiative associated with the largest decrease in GHG emissions as well as the biggest annual cost savings for the Town. The *Energy Management for Town Owned Buildings Policy* also resulted in a large decrease in GHG emissions. However, a reduction in GHG emissions could not be attributed to the *Procurement Policy*. A more specific procurement policy might result in a larger reduction in GHG emissions.

The most effective Community initiative was the reduction in plastic bag use. A reduction in plastic bag use is not associated with a policy or by-law implemented by the Town. The Town looked into implementing a policy to increase the use of reusable bags but because of the frequency of plastic bag use by Annapolis residents and measures put into place by grocers a policy was deemed to be redundant. The survey conducted in 2012 revealed a strong awareness for some of the Town's environmental initiatives such as the *Idling Control Policy* and the *Zero Waste Initiative* but less awareness for other initiatives such as the *Invasive Alien Species Policy*. Promotion of some policies, such as the *Invasive Alien Species Policy*, could increase their effectiveness.

Recommendations to the Town based on the GHG inventory and evaluation of individual initiatives are reported in section 5.0.

3.0 Greenhouse Gas Emissions Inventory

In 2008, an inventory of GHG emissions in the Town was completed by CARP. This inventory estimated the amount of GHGs that were emitted by human activity in the Town in the baseline year. The baseline year consists of data from 2006, with two exceptions: unmetered electricity consumption for Town owned buildings and solid waste production.

Nova Scotia Power changed the way in which it metered electricity in 2007. Prior to 2007 data was not available for total electricity consumption for unmetered usage. Unmetered electricity usage in the Town consists of streetlights. Therefore, kilowatt hours of unmetered electricity use were reported for 2007 instead of 2006. The mass and composition from solid waste in the Town was gathered from a report called "Assessing Progress Towards Zero Waste: A review of services and facilities" which reported 2005 data.

Both the baseline and the current report follow the guidelines set out in IEAP. IEAP divides different sources of emissions into different scopes for reporting greenhouse gas reductions. The purpose of this is to prevent GHGs from being counted multiple times. Scope 1 consists of direct emissions while Scope 2 includes indirect emissions from electricity, district heating, steam, and cooling consumption. Scope 3 emissions consist of all other indirect emissions. It is required by the PCP and the IEAP to report Scope 1 and Scope 2 emissions. In the case of quantifying emissions from transportation, Scope 3 data will also be included.

The baseline report segregated the Town into different components and measured the energy consumption and CO_2e for each sector. The sectors were:

- The Corporate Town of Annapolis Royal (CTAR);
- The Institutional, Commercial, and Industrial (ICI) sector; and
- The Residential/Small Business Sector (RSB).

The CTAR sector includes any fuel or electricity use that is paid for by the Town or emitted by town owned buildings. This includes energy used for space heating, lighting and appliances, and transportation. Community emissions consist of any energy used by residents, industry, businesses, and institutions including energy used for space heating, lighting and appliances, and transportation. The baseline report had a separate category for GHGs emitted in the ICI sector and the RSB sector. However, it neglected to include emissions from on-road transportation for non-Town owned vehicles and emissions originating from solid waste management. On-road transportation and solid waste emissions were therefore estimated for 2006 and included in the inventory for Community GHG emissions in this report. Some facilities owned or operated by the Town were not included in CTAR emissions in the baseline report. To accurately measure increases or decreases in the Town's greenhouse gas emissions while meeting PCP and IEAP reporting requirements, the baseline CTAR inventory has been updated to include these sources.

Data on electricity consumption for the baseline report was collected for 2006 and 2007 and were provided by Nova Scotia Power. These two years display drastically different energy uses and resulting CO_2e emissions. In 2006 total metered electricity use equaled 185,277 kWh. In 2007 total metered electricity use was found to be 305,169 kWh. The author of the 2008 inventory suggested that a shift in water treatment methods to ultraviolet disinfection of water could explain the sizable change in energy consumption in these two years. As of 2011 the Town still uses ultraviolet light to treat its water. Due to routing changes in 2007 for power meters, only total metered and unmetered energy consumption is available for 2007. Total unmetered electricity use was not available for 2006. Unmetered electricity use consists of energy used by street lighting and traffic control which is estimated by wattage. Metered electricity use consists of electricity used for water treatment and utility, the Farmers Market, Town Hall and Public Works.

To collect data on energy consumption for 2011 a mail survey was sent out in March 2012 to residents to determine energy consumption for space heating and hot water in the home owner and small business sector. Estimates for energy consumption in the ICI sector were based on interviews with managers. Data collected on energy consumption was then converted then into CO_2e units using conversion factors provided by the Nova Scotia Union of Municipalities (UNSM) (Table 5).

Table 5 2007 CO_2e GHG conversion factors provided by the UNSM Corporate Energy Emissions Inventory.

Furnace Oil	2.68 kg CO_2e per litre
Gasoline	2.34 kg CO_2e per litre
Diesel	2.63 kg CO_2e per litre
Propane	1.52 kg CO_2e per litre
Electricity (2006 for Nova Scotia)	0.868 kg CO_2e per litre

The baseline report originally found that a total of 12,217.1 tonnes of CO_2e were produced. Approximately 96.4% of this originated from the Community while the remaining 3.6% were emitted by CTAR. The updated baseline found that 13,100 tonnes of CO_2e were produced when updates to the inventory were included.

A second GHG inventory for the Town has been completed as part of this report. It includes GHG emissions from the 2011 calendar year. The sectors that the Town was divided into for the baseline report were maintained. Conversion factors provided by the UNSM for 2007 (Table 5) were used to calculate GHG emissions from furnace oil, gasoline, diesel, and propane. An updated electricity conversion factor from Nova Scotia Power was used. Formulas and calculations used to quantify GHGs released from the Town are recorded in Appendix B. This inventory found that the Town of Annapolis Royal emitted 8,500 tonnes CO_2e in 2011, a reduction of 4,600 tonnes CO_2e.

3.1 Corporate Town of Annapolis Royal Greenhouse Gas Emissions

Emissions from CTAR are defined as any energy use that is directly paid for by the activities of the administration of the Town. In the updated baseline inventory energy emissions from CTAR totaled 470.03 tonnes of CO_2e. These emissions were divided by source into five categories:

- Space Heating;
- Transportation: Gasoline;
- Transportation: Diesel;
- Metered Electrical; and
- Unmetered electrical.

In this report GHG emissions from CTAR are divided into:

- Buildings and Facilities
- Fleet Vehicles
- Streetlights and Traffic Lights
- Water and Sewage.

In 2011 a total of 358.0 tonnes CO_2e were emitted by CTAR. This is a decrease of approximately 112 tonnes from the baseline year. Overall, emissions from CTAR decreased between 2006 and 2011. Emissions from fleet vehicles has increased, largely because the local police department added an additional vehicle to the fleet and increased patrol time. There was a decrease in GHG emissions from all the remaining sectors. The most dramatic decrease was from Streetlights and Traffic Signals which decreased from 77.70 tonnes CO_2e from the baseline to 25.68 tonnes CO_2e in 2011.

Table 6 Results of the CTAR GHG inventories for the Town from 2011and 2006.

Sector	2006 Emissions (tonnes CO_2e)	2011 Emissions (tonnes CO_2e)	CO_2e emissions trend from 2006 to 2011
Buildings and Facilities	232.0	181.7	↓ 22%
Fleet Vehicles	42.20	59.53	↑ 41%
Streetlights and Traffic Signals	77.70	25.68	↓ 67%
Water and Sewage	118.1	91.06	↓ 15%
Total	*470.0*	*358.0*	*↓ 24%*

3.1.1 Buildings and Facilities

The Farmers' Market's winter location is in the Historic Gardens whose total furnace oil use is reported in the baseline report's ICI sector and therefore to prevent including Farmers' Market emissions twice GHGs emitted from space heating are not included in the CTAR sector. Electricity usage for the Buildings and Facilities sector was calculated using billing records. Electricity usage for

the Buildings and Facilities sector was 145,937 kWh while heating and furnace oil consumed 37,945 L of furnace oil. In total, 232 tonnes CO_2e was produced by this sector.

Table 7 GHG emissions from heating and electricity use in the buildings and facility sector in 2006.

Facility	Heating			Electricity		Total CO_2e (tonnes)	2006 Emissions per facility
	Cost ($)	Furnace Oil (l)	CO_2e (tonnes) emissions	Energy Usage (kWh)	CO_2e (tonnes) emissions		
Public Works	3,500	5,822	15.8	13,020	11.59	27.4	12%
Town Hall	4,200	7,305	19.6	38,095	33.91	53.5	23%
Farmers' Market	-	-	-	1,462	1.30	1.3	1%
Fire Department	11,600	16,042	43.0	69,600	61.96	105.0	45%
King's Theatre	5,300	8,776	23.5	23,760	21.15	44.7	19%
Total	*24,600*	*37,945*	*101.9*	*145,937*	*129.91*	*231.8*	*100%*

To calculate energy consumption in the Buildings and Facilities sector for the 2012 inventory the Town's financial records were used to obtain the exact number of kilowatt hours of electricity and the liters of fuel used. Electricity usage accounted for more GHG emissions than fuel use in this sector. The Fire Department was the largest consumer of energy while the weekly Farmers' Market used the least.

Table 8 GHGs emitted in 2011 for heating and electricity in the CTAR buildings and facilities sector.

Facility	Heating			Electricity		Total CO_2e (tonnes)	2011 Emissions per facility
	Cost ($)	Furnace Oil (l)	CO_2e emissions (tonnes)	Energy Usage (kWh)	CO_2e emissions (tonnes)		
Public Works	5,475	5,660.5	15.2	11,144	9.2	22.9	13%
Town Hall	4,970	5,111.9	13.7	27,770	23.0	38.1	21%
Farmers' Market	-	-	-	2,700	2.2	2.2	1%
Fire Department	10,546	10,691.0	28.7	58,140	48.2	76.9	42%
King's Theatre	8,160	8,412.4	22.5	23,040	19.1	41.6	23%
Total	*29,151*	*29,875.8*	*80.1*	*122,794*	*101.7*	*181.8*	*100%*

All facilities in this sector with the exception of the Farmers' Market decreased their greenhouse gas emissions in this sector. In total this sector used 181.8 tonnes CO_2e in 2011. This is a decrease of 22% from the baseline. This is possibly due to environmental initiatives such as the

Town's Energy Management Policy which seeks to reduce the environmental impact of town-owned buildings.

Table 9 A comparison of GHGs emitted in the CTAR buildings and facilities sector in 2006 and 2011.

Facility	2006 CO_2e emission (tonnes)	2011 CO_2e emissions (tonnes)	CO_2e emissions trend from 2006 to 2011
Public Works	27.4	22.9	↓ 16 %
Town Hall	53.5	38.1	↓ 29 %
Farmers' Market	1.3	2.2	↑ 72 %
Fire Department	105.0	76.9	↓ 27 %
King's Theatre	44.7	41.6	↓ 7 %
Total	*231.8*	*181.8*	↓ *22 %*

3.1.2 Fleet Vehicles

The Fleet Vehicles sector was reported as Transportation in the baseline report. The Transportation, or Fleet Vehicles sector, consists of the gasoline and diesel for vehicles that the Town owns or operates. The data was compiled by the Town's administrative staff based on their financial records. Some of these emissions may have occurred outside of Town as the Fire Department services areas outside of the Town of Annapolis Royal.

Table 10 GHG emissions from diesel and gasoline consumed in the fleet vehicles sector in 2006.

User	Gasoline			Diesel			Total CO_2e (tonnes)	2006 Emissions per user
	Cost ($)	Fuel Usage (l)	CO_2e (tonnes)	Cost ($)	Fuel Usage (l)	CO_2e (tonnes)		
Public Works	2,100	3,074	7.2	2,700	3,502	9.2	16.4	39%
Police Department	3,000	4,343	10.2	-	-	-	10.2	24%
Fire Department	2,000	3,155	7.4	2,100	3,145	8.3	15.7	37%
Total	*7,100*	*10,572*	*24.8*	*4,800*	*6,647*	*17.4*	*42.3*	*100%*

Public Works accounted for 39% of the total CO_2e emissions for this sector, the Fire Department contributed to 37% of total CO_2e emissions while the Police Department, which only uses gasoline fuel vehicles produce 24% of total emissions in the Fleet Vehicles sector. Gasoline use produced a total of 24.8 tonnes of CO_2e and diesel produced 17.4 tonnes of CO_2e which results in a total of 42.2 tonnes CO_2e for the baseline year from the Town's vehicle fleet

Total emissions originating from CTAR owned and operated vehicles were 59.5 tonnes CO_2e in 2011. This is an increase from the 42.3 tonnes CO_2e emitted by this sector relative to the baseline. Approximately 70% of this is from gasoline using vehicles while the remaining 30% was generated by diesel fuel. This has changed from 2006 when only 60% on the total emissions were due to gasoline fueled vehicles. The amount of CO_2e emissions due to diesel has actually slightly decreased, but this was offset by an increase in emissions from gasoline-fueled vehicles. This

increase is due to the Police Department which has increased in size since the baseline year when there was only one police vehicle; in 2009 a second vehicle was purchased and patrol time has doubled. This accounts for the large increase in emissions from the Police Department.

Table 11 GHGs emitted from gasoline and diesel by CTAR's fleet vehicles in 2011.

User	Gasoline			Diesel			Total CO_2e (tonnes)	Percent of 2011 Emissions
	Cost ($)	Fuel Usage (l)	CO_2e (tonnes)	Cost ($)	Fuel Usage (l)	CO_2e (tonnes)		
Public Works	2,996	3,655	8.6	4,330.56	5,068	13.3	21.9	37%
Police Department	9,566	11,635	27.2	-	-	-	27.2	45%
Fire Department	2,378	2,881	6.7	1,246.14	1,421	3.7	10.5	18%
Total	*14,940*	*18,171*	*42.5*	*5,576.7*	*6,489*	*17.0*	*59.5*	*100%*

To calculate emissions from CTAR transportation billing records were provided by the Town. These recorded the cost of the fuel as well as the amount of fuel used for each vehicle. To calculate the GHG equivalents from the fuel used UNSM's 2007 CO_2 Greenhouse Gas Conversion Factors (Table 5) were used.

Table 12 A comparison of GHGs emitted in the CTAR fleet vehicles sector in 2006 and 2011.

User	2006 CO_2e emissions (tonnes)	2011 CO_2e emissions (tonnes)	CO_2e emissions trend from 2006 to 2011
Public Works	16.4	21.9	↑ 33%
Police Department	10.2	27.2	↑167%
Fire Department	15.7	10.5	↓ 33%
Total	*42.3*	*59.5*	↑ *41%*

3.1.3 Streetlights and Traffic Signals

The baseline total unmetered electricity usage, consisting of streetlights and traffic signals, was measured as 89,028 kWh. Using Nova Scotia Power's GHG emission intensity estimate for 2007 a total of 77.700 tonnes of CO_2e was released in this sector for the course of the year.

Emissions from streetlights for 2011 were calculated using the kWh used in 2007 and then subtracting the energy savings that were achieved by upgrading to LED lights. The emissions from streetlights and traffic signals were found to be 31,000 kWh. The resulting GHG emissions for this sector were 25.68 tonnes CO_2e. This is a decrease of 52.02 tonnes CO_2e relative to the 77.700 tonnes CO_2e emitted in the baseline year.

Table 13 A comparison of GHG emitted by Streetlights and Traffic Signal in Annapolis's CTAR sector in 2006 and 2011.

Facility	2007 Energy Usage (kWh)	2006 CO_2e emissions (tonnes)	2011 Energy Usage (kWh)	2011 CO_2e emissions (tonnes)	CO_2e emissions trend from 2006 to 2011
Streetlights and Traffic Signals	89,028	77.7	31,000	25.7	↓ 67%

3.1.4 Water and Sewage

In the baseline report, Water and Sewage emissions and Buildings and Facilities emissions were grouped together in the Electrical Consumption sector. To meet ICLEI reporting requirements while keeping reporting consistent Water and Sewage emissions and Building and Facilities emissions in the baseline report have been separated and are each recorded as a different sector.

Table 14 GHGs emitted in 2006 in order to provide water and sewage treatment services to the residents of Annapolis Royal.

Facility	Energy Usage (kWh)	CO_2e emissions (tonnes)	Percent of Emissions
Sewage Lines/Lift Stations	36,070	32.1	27%
Sewage Treatment Plant	80,550	71.7	61%
Water Utility	16,080	14.3	12%
Total	*132,700*	*118.1*	*100%*

In 2006 the sewage treatment plant used the majority of the energy in this sector. In total, this sector generated 118,125 kg or 118 tonnes CO_2e. To quantify 2011 GHG emissions from the Water and Sewage sector billing records from the Town were used to determine total energy consumption for each facility. Emissions from the Water and Sewage sector consists of the electricity required to provide water and sewage services for the Town. Indirect emissions and emissions generated by sewage are not included in the scope of this sector.

Table 15 GHGs emitted in 2011 in order to provide water and sewage treatment services to the residents on Annapolis Royal.

Facility	Energy Usage (kWh)	CO_2e emissions (tonnes)	Percent of Emissions
Sewage Lines/Lift Stations	11,640	9.6	11%
Sewage Treatment Plant	86,264	71.5	78%
Water Utility	12,013	10.0	11%
Total	*109,918*	*91.1*	*100%*

A total of 91,055 kg CO_2e or 91.055 tonnes of CO_2e were emitted by the sector in 2011. This is a 23% decrease in emissions since the baseline year when a total of 118.1 tonnes CO_2e were emitted by this sector. The most drastic decrease in energy consumption was from sewage lines and

lift stations. In the baseline year a total of 32,108 kg CO_2e was released to due to electricity consumed by this facility. By 2011 this decreased by 70% to 9.6 tonnes CO_2e.

Table 16 A comparison of GHGs emitted by Water and Sewage in the CTAR sector in 2006 and 2011.

User	2006 CO_2e emissions (tonnes)	2011 CO_2e emissions (tonnes)	CO_2e emissions trend from 2006 to 2011
Sewage Lines/Lift Stations	32.1	9.6	↓ 70%
Sewage Treatment Plant	71.7	71.5	↓ 0.3%
Water Utility	14.3	10.0	↓ 30%
Total	*118.1*	*91.1*	↓ *23%*

3.2 Annapolis Royal Community Greenhouse Gas Emissions

GHG emissions for the Town of Annapolis Royal were found to have decreased since the baseline year. Some of this decrease is likely due to change in methodology in the ICI sector since the baseline year. This report differentiated between small businesses and commercial enterprises based on the Town's zoning. It could not be determined how the author of the baseline report differentiated between small business and commercial.

Table 17 GHG Emissions from Community of Annapolis Royal in 2011

Sector	2006 CO_2e emissions (tonnes)	2011 CO_2e emissions (tonnes)	CO2e emissions trend from 2006 to 2011
Residential and Small Business	4,151.2	4,404.5	↑ 6%
Institutional, Commercial, and Industrial Sector	7,622	2,902	↓ 62%
Transportation	798	728	↓ 9%
Solid Waste	102	89	↓ 13%
Total	*12,673.2*	*8,123.5*	↓ *36%*

3.2.1 Residential and Small Business Sector

To collect data for energy consumption in the RSB sector for the baseline year 183 confidential, mail-in questionnaires were sent out to homeowners yielding 43 replies. Nova Scotia Power also provided data about energy consumption. The inventory found that in the base year a total of 4,151.2 tonnes of CO_2e were being released in the Town's Residential and Small Business Sector. Electricity usage accounted for 2,626.2 tonnes or this while oil use caused the remaining 1,889 tonnes CO_2e.

The survey in 2012 yielded 49 replies, however Nova Scotia Power was unable to provide data on electricity consumption in 2011 due to changes in monitoring. To calculate residential GHG emissions, energy consumption was averaged for each fuel source. Total energy consumption for the

Town was inferred from this average taking into account the percentage of households who use each energy source.

Table 18 GHG (kg CO_2e) production in 2011 by fuel source for the Residential and Small Business sector of the Town

Fuel Source	Energy Usage	CO_2e emissions (tonnes)
Propane	17,961 L	27.3
Furnace Oil	603,352 L	1,617.0
Electricity	3,332,062 kWh	2,760.2
Total	-	*4,404.5*

In accordance with IEAP emissions from burning wood have been omitted. This is because burning biomass cycles carbon that was previously included in the carbon cycle. Other fuel sources such as propane, furnace oil, and electricity release carbon that was not in the carbon cycle but was stored in fossil fuels.

Emissions from the Town's residential and small business sector have slightly increased from 4,151.2 tonnes CO_2e to 4,404.5 tonnes CO_2e. There has been a decrease is GHG emissions from furnace oil, but this was offset by an increase in electricity usage.

Table 19 A comparison of GHGs emitted by the Town of Annapolis Royal's Residential and Small Business sector in 2006 and 2011.

Fuel Source	2006 CO_2e emissions (tonnes)	2011 CO_2e emissions (tonnes)	CO_2e emissions trend from 2006 to 2011
Propane	-	27.3	-
Furnace Oil	1,889.0	1,617.0	↓ 14%
Electricity	2,606.2	2,760.2	↑ 5%
Total	*4,151.2*	*4,404.5*	↑ *6%*

3.2.2 Institutional, Industrial, and Commercial Sector

In order to compile the GHG emissions originating from the ICI sector energy consumption for the baseline year, individual businesses and institutions were asked to report their non-electrical energy consumption. Values for electricity use were provided by Nova Scotia Power. The baseline inventory found that in the base year a total of 7,622.2 tonnes of CO_2e were being released by the Town's Residential and Small Business Sector. The UNSM Corporate Energy Emissions Inventory estimations of greenhouse gas emissions by fuel source (Table 5) were used to calculate CO_2e.

Table 20 GHG Emissions generate by Annapolis Royal's ICI Sector in 2006 by energy source.

Energy Source	Energy Usage	2006 CO_2e emissions (tonnes)	Percent of Emissions
Furnace Oil	251,612 L	674.5	9%
Propane	3,878 L	5.9	0.1%
Diesel	668 L	1.8	0.03%
Electricity	7,995,515 kWh	6.940	91%
Total	-	*7,622.2*	*100%*

Electricity usage for the ICI sector of Annapolis Royal was not available from Nova Scotia Power as it was for the baseline report. To collect data for 2011 businesses and institutions were grouped with other facilities in the ICI sector with similar energy uses. Energy consumption data was gathered from 22 facilities in the ICI sector from different categories. Energy usage for each category was inferred from this data.

Businesses that were located in residential zones were considered to be "small businesses" and were not included in the ICI sector. Since it could not be determined what was grouped under the Residential and Small Business sector in the baseline inventory and what was placed in the ICI sector, business included in the ICI sector in the baseline year might be included in the Residential and Small Business sector in 2011, and vice versa. This could create inconsistency in the results between the baseline and 2011.

In 2011 GHG emissions in the ICI sector were found to be 2,902 tonnes of CO_2e. Significantly lower than the GHG emissions in the baseline year. The difference between these numbers might be due to excluding many Bed and Breakfasts and Art Galleries from the ICI Sector and including them in the Small Business and Residential Sector instead.

3.2.3 On-road Transportation

To calculate total transportation within the Town GHG emissions from tourists and from residents were calculated separately. To calculate tourism in the Town the total number of tourists in Nova Scotia was used from Tourism Nova Scotia's visitation statistics. Nova Scotia tourism also conducts exit surveys and records the places that tourists visit. These exit surveys provided information on the percentage of people who visit Annapolis Royal and the number of nights they stay. Exit surveys are conducted every 6 years. Therefore, data was used from 2004 and 2010. In 2004 2,208,100 people visited Nova Scotia. Of these 13% visited Annapolis Royal. Approximately 3% stayed overnight and 10% visited for a day or less. Therefore, approximately 220,800 people visited Annapolis Royal for a day or less in 2004. Another 66,200 stayed overnight for an average length of 2.6 days. This means that there were approximately 1,076 tourists in Town each day in 2004.

In 2010 there were was a total of 2,123,100 visitors to Nova Scotia. Of these, 13% visited the Town of a day or less and 1% stayed overnight for an average of 2.4 nights. This means that there were approximately 896 tourists in Town each day in 2010.

The 2012 survey asked Town residents how often they used a car to travel within the Town. On average, residents of the Town indicated that they used their car 3.8 times per week. The Town's population is 481. Therefore, Town residents collectively use their cars approximately 1,828 times per week. It could not be determine whether this number has changed since the baseline year. Therefore, for both the baseline and 2011 inventory the value 1,828 will be used for resident car usage per week.

There are also people who live in the rural areas around Town who come into Town to purchase groceries, work, etc. The local grocery stores were contacted and approximately 5,900

people visit these locations each week and it was assumed that each household goes to the grocery store once per week.

Therefore, it was calculated that approximately 13,700 cars are driven through Annapolis over the course of one week in 2010 while in 2004 approximately 15,000 cars drove through the Town each week. The main street (St. George Street) in the Town along which most stores and restaurants are located is approximately 2.3 kilometers long. Therefore, in a week a total of 3,277,040 km were driven in Annapolis is 2010 while in 2004 357,800 km was driven. An estimate of average fuel consumption per 100 km was generated by the Town for the *Bicycle Loan Program*. This estimate, 9.5 L/100 km will be used to calculate L of gasoline consumed. In 2004 approximately 340,900 L of gasoline was used for transportation in Town. In 2010 this number decreased to 311,300 L of gasoline.

Table 21 GHG Emissions from Transportation in the Town in 2004 and 2010

Year	Distance Traveled (km)	Energy Usage (l)	CO_2e emissions (tonnes)
2004	3,578,400	340,900	798
2010	3,277,000	311,300	728

In 2004 transportation in Town accounted for the release of approximately 798 tonnes CO_2e. In 2010 transportation accounted for approximately 728 tonnes CO_2e of GHG emissions. This estimate assumed that the fuel source for the cars was gasoline. This estimate does not factor in large trucks.

3.2.4 Solid Waste

The Town's original GHG inventory compiled in 2008 did not include GHG emissions generated by the Community's solid waste management practices. In 2005 a report called "Assessing Progress Towards Zero Waste: A review of services and facilities" was prepared by Lura Consulting for the Town. This assessment recorded the amount of recycling, compost, and garbage being produced by the Town. The report also randomly sampled recycling and garbage bags to estimate the composition of each stream and the amount of material being incorrectly sorted. The findings of the Zero Waste Report that are relevant to Milestone 5 are summarized in Table 22.

Table 22 The amount of waste, recycling, and compost produced by the community of Annapolis in 2005 and the amounted of incorrectly sorted organics in the stream estimated by randomly sampling garbage and recycling bags and sorting and weighing the contents of the bags.

Stream	Amount Produced (tonnes/year)	Waste per Stream	Amount of incorrectly sorted organics (tonnes)
Waste	102	41 %	12.24
Recycling	48	19 %	0
Compost	104	40 %	N/A
Total	**254**	**100 %**	**12.24**

This data was used to calculate the amount of GHGs generated by the town's solid waste production. The default method outlined in the 1996 IPCC Guidelines for National GHG Inventories and IEAP was used to calculate these estimates. Two formulas provided by the IEAP were combined and used.

The Town's waste management involves transporting garbage and recycling produced by the town to Kaizer Meadows, a waste management facility in Chester, Nova Scotia. Here the solid waste is stored in anaerobic conditions. Under these conditions any organic material remaining in the garbage produces methane. Methane is one of the most important greenhouse gases as it is estimated to be 21 times more potent than carbon dioxide. Therefore, one unit of methane is equal to 21 units of CO_2e.

Total emissions for 2005 are approximately 0.816 tonnes CH_4 or 17.136 tonnes of CO_2e. To calculate solid waste emissions for 2011 the Town's financial records were consulted. These records revealed that 88.970 tonnes of garbage was collected from the Town in 2011. This is consistent with IPCC prescribed default values (IPCC 1996). Based on the "Zero Waste" report, which found that approximately 12% of the material in the garbage waste stream was organic material, approximately 10.68 tonnes of organics is deposited by Annapolis residents into the Kaizer Meadows waste facility each year. The resulting emissions were 0.712 tonnes of methane which is equivalent to 14.952 tonnes CO_2e.

Table 23 A comparison of GHG emitted by Streetlights and Traffic Signal in Annapolis's CTAR sector in 2006 and 2011.

Source	2006 Waste Production (tonnes)	2006 CO_2e Emissions (tonnes)	2011 Waste Production (tonnes)	2011 CO_2e Emissions (tonnes)	CO2e emissions trend from 2006 to 2011
Solid Waste	102	17.136	89	14.952	↓13%

4.0 Participation and Engagement

The Town has engaged many organizations to help them develop and implement environmental initiatives and policies. The following organizations, agencies, and departments were partners in developing or implementing environmental measures:

- Nova Scotia Power Inc.;
- LED Roadway Lighting;
- Historic Gardens;
- Clean Annapolis River Project;
- Annapolis Digby Economic Development Agency;
- Parks Canada;
- Annapolis Heritage Society;
- Brown Bros. Excavating Ltd.; and
- Retail stores within the Town.

4.1 Community Engagement

Community engagement has helped to shape the environmental initiatives that the Town has produced. When the *By-Law to Permit the Production and Distribution of Energy from Specific Renewable and Green Energy Sources* was implemented the Town's Environment Committee was formed. This Committee is composed of concerned citizens of Annapolis Royal. The group identifies environmental issues that they feel the Town should address and makes recommendations to council on how to address these issues. The Town's *Idling Control Policy* is one of their recommendations.

The GHG emission reductions associated with the increase in renewable plastic bag use resulted from Town resident's choices and the actions of grocers in Town rather than a By-law or policy implemented by the Town. Additionally, the success of some environmental initiatives, such as the LED Holiday Light Exchange Program, was dependent on the participation of Town residents.

4.2 Resident Recommendations from Survey

Included in the survey was a question on what environmental initiatives the residents would like to see the Town implement. There were some trends that emerged in the answers to this question:

- 7 respondents indicated that they were interested in seeing renewable energy, particularly geothermal and solar, developed further in Town. It should be noted that the immediately preceding question was about renewable energy. This potentially prompted people to recommend the further development of renewable energy in Annapolis Royal;
- 5 residents expressed their interest in reducing GHG emissions through reducing car use. The respondents had different recommendations about how to achieve this. One said that the Town should maintain its support for public transport, several said that the Town should encourage walking, and another resident suggested that the Town promote a ride sharing database for out of Town trips;
- 5 respondents indicated that they were interested in improved outreach and public education.
- 5 respondents recommended that the Town adopt curbside compost pick-up;
- 4 respondents recommended the installation of more LED lights; and
- 3 residents indicated that they were interested in the establishment of community gardens.

A complete list of the responses copied verbatim can be found in Appendix D.

5.0 Conclusion and Recommendations

<u>More Specific Procurement Policy & Sustainable Town Hall practices</u>

The Town's *Procurement Policy* includes environmental impacts as a factor for consideration. It also dictates that Energy Star and local products will be preferred. However, Town staff were unable to identify products which were chosen due to their environmental impact. To promote

sustainable choices the Procurement Policy could be more specific and other day to day practices could be adopted such as:

- purchasing paper must containing at least 40% post-consumer recycled content and/or be derived from FSC certified woodlots.
- compostable or re-usable pens and other stationary items should be considered first.
- adopt a bylaw or policy for paper free (electronic) meetings (e.g. Town Council meetings).
- publish the "Town Crier" online on the Town's website in lieu of mail outs.
- have all computers in Town owned buildings default to double-sided printing

The emissions from the production and shipment of paper use can be easily measured for CO_2e.

LED Lights in King's Theatre

Unlike the other Town owned buildings no LED lights were installed in King's Theatre. However, given the decrease in GHG emissions that occurred in Town Hall and the Fire Department after their lighting was upgraded it seems that installing LED lights in King's Theatre would decrease GHG emissions as well as reduce costs. The payback period for both Town Hall and the Fire Department was less than a year and there were cost savings of over one thousand dollars per year in both cases. Furthermore, each of these upgrades decreased the tonnes of CO_2e released in the Town by several tonnes.

Curbside Composting Program

The 2005 Zero Waste Assessment report found that 12 % of the material in the waste stream was compostable, organic material. An interview with a manager at the Kaizer Meadow landfill revealed that approximately 1% of the material in the waste stream there is compostable, organic waste. This means that the Town of Annapolis Royal has more compostable material going to the landfill then other municipalities in the region. This may be because of the lack of curbside compost pickup. Of the 49 surveyed in 2012, 7 households indicated that they disposed of their compostable organic material in the garbage. While 37 households responded that they could easily dispose of their organic waste 12, or 24%, of respondents reported that there were obstacles to disposing of their organic waste.

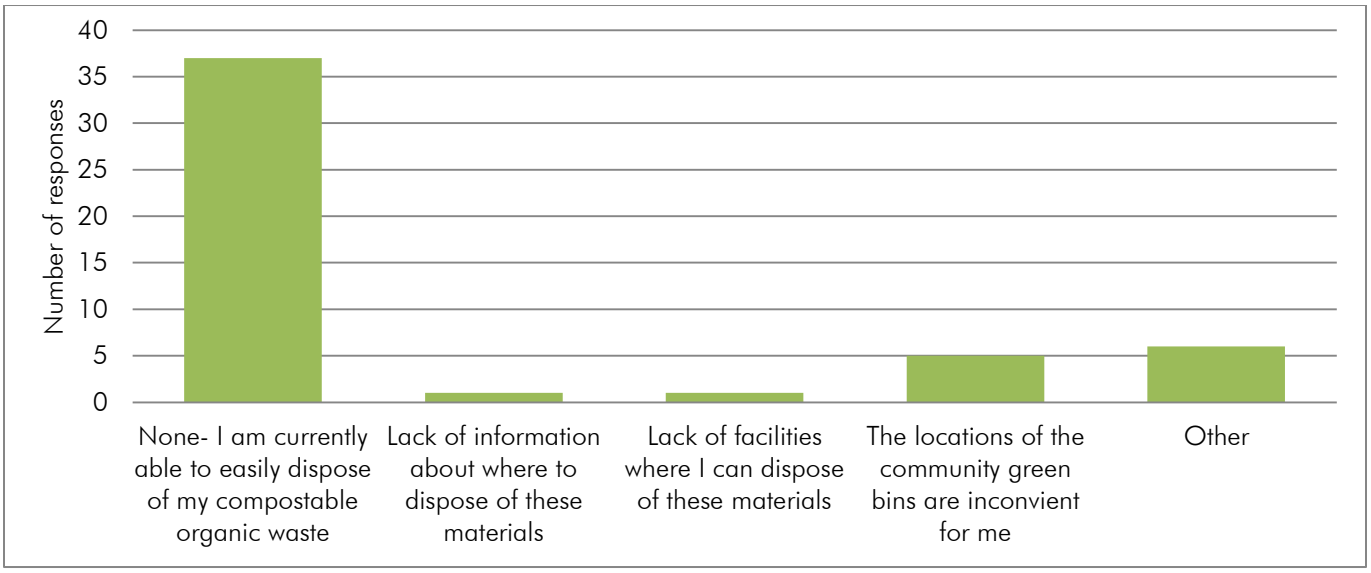

Figure 6 Responses to the question "What is/are the biggest obstacle(s) in disposing of your compostable organic waste?" in the 2012 survey of Town households.

Of the 6 who responded "other" 4 indicated that transportation to the community collection bins was a significant obstacle. The other two households reported that not having a green bin in their apartment to sort out waste and animals in backyard composters were the main barriers to composting. Curbside compost collection may remove these obstacles and increase the correct sorting of waste in the Town.

When organics decompose in landfills they do not have proper access to oxygen and so release methane, a potent GHG, as they decompose. The excess organic material in that Annapolis sends to the Kaizer Meadow landfill relative to other municipalities generates 6.511 tonnes CO_2e per year. The local waste collection facility for Valley Waste transports waste to their Lawrencetown facility and then transports the organic waste to Aylseford. The GHG emissions for the transport of Annapolis's waste to Aylesford as part of Valley Waste would only be 4.264 tonnes CO_2e. Assuming that a curbside compost program removed obstacles to composting this would result in a reduction in GHG emissions.

Address Renewable Energy Barriers

Of the 49 Town residents surveyed 53% indicate that they were interested in installing renewable energy. The next question asked what the main obstacle(s) to installing renewable energy were for residents. While some barriers, such as the cost of purchasing and/or installation may not be feasible for the Town to address others such as "the historical requirements of Town" can be addressed by promoting and/or altering the already existing *By-Law to Permit the Production and Distribution of Energy from Specific Renewable and Green Energy Sources*. This By-Law provides guidance on installing renewable energy devices while adhering to the historical requirements of the Town.

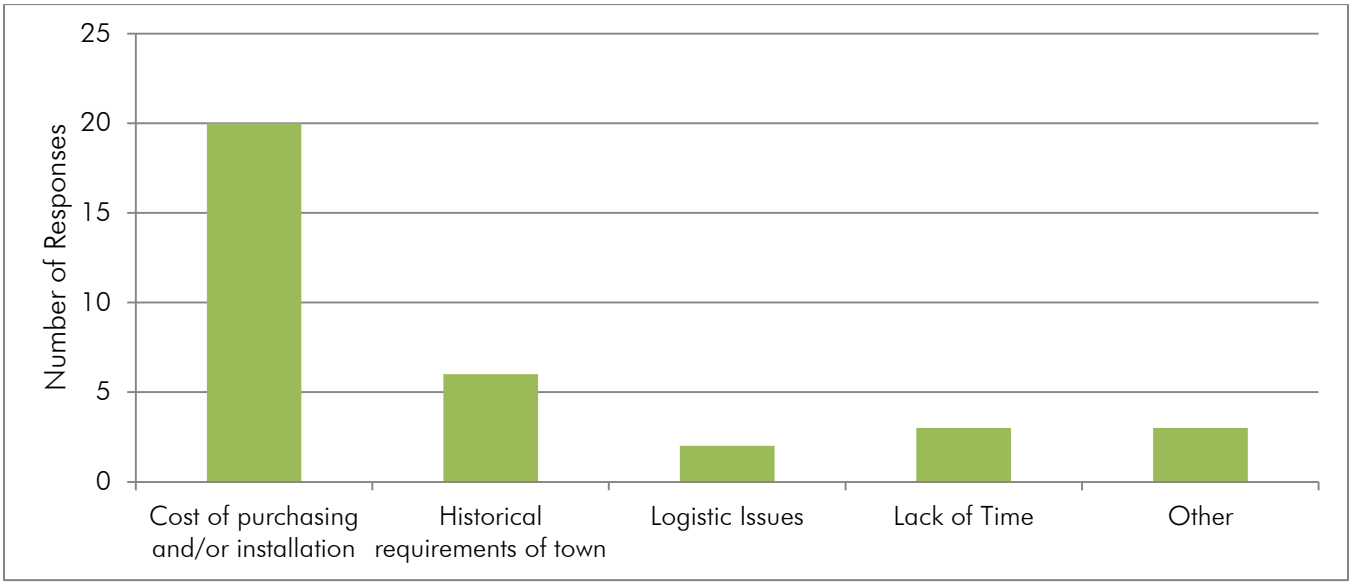

Figure 7 Obstacles to installing renewable energy devices in households in the Town of Annapolis Royal

Of those the four who responded "other" to the question "what is the main obstacle preventing you from installing renewable energy on your property?", two indicated that a lack of information was an obstacle. Links on the Town's website or information about renewable energy in the Town's newsletter could help alleviate this obstacle.

Stormwater Pond for Fire Hall

In the past 15 years the Town has worked to separate stormwater and sanitary sewers. This relieves pressure on the treatment plant and reduces the likelihood of inputting more water than the treatment plant can handle. However, stormwater is diverted into a nearby water course without prior treatment. Stormwater often carries contaminants, such as hydrocarbons, which then pollutes the water way. A proposal was made to construct a stormwater retention pond which would serve as a water source for practice at the Volunteer Fire Department. The stormwater pond would improve the water quality as suspended sediments and contaminants settle out of the water. The water can also be further treated by plants, algae, and bacteria that live in the pond.

The construction of the Stormwater Pond has yet to be completed and it, would provide several benefits, such as habitat for wildlife, water treatment, and conserve drinking water used for the fire training exercises.

Promotion of Initiatives

In the survey distributed to the Town residents in 2012, households were asked which Town environmental initiatives they were aware of. Some initiatives, such as the *Idling Control Policy* and the *Zero Waste Initiative,* were known of by many Town residents. Others, such as the *Invasive Alien Species Policy* and the *By-Law to Permit the Production and Distribution of Energy from Specific Renewable and Green Energy Sources*, were less well known. Promoting these policies could

enhance their effectiveness. Additionally, several of the survey respondents indicated that they would like to see the Town promote the policies and by-laws to help residents of Annapolis Royal stay informed about Town initiatives

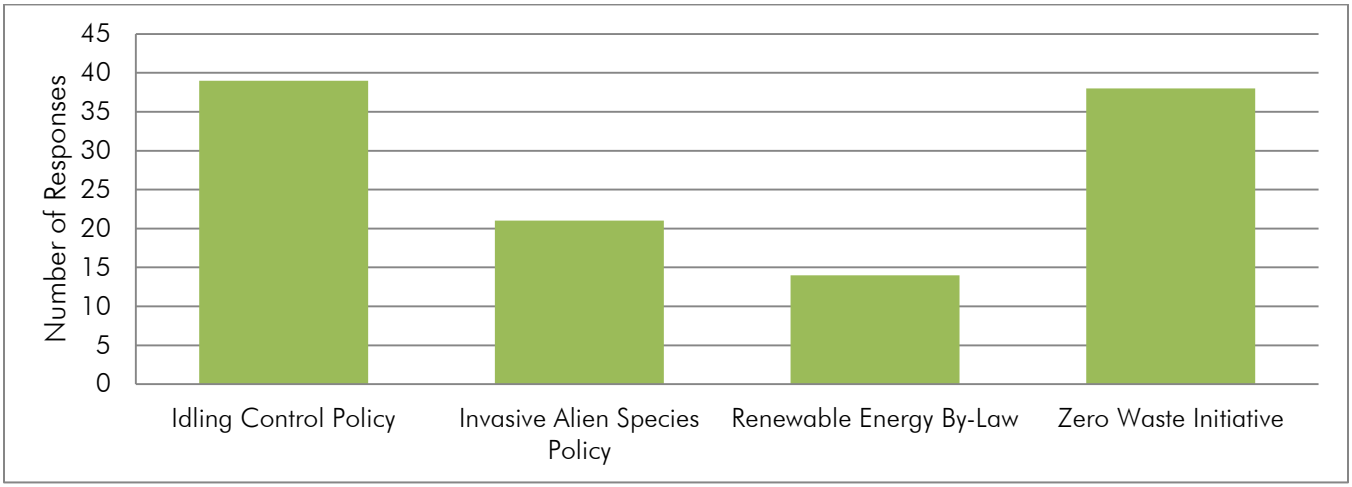

Figure 8 Responses to the question "Which of the following town initiatives are you aware of?" in the 2012 survey.

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Appendix A: Calculations for Greenhouse Gas Reduction by Initiative

Bicycle Loan Program

To calculate reduced energy consumption:
= Usage per week X Weeks in Use X Hours of Use Per Day X Kilometers Traveled X Litres/Kilometer
= 4.5 day/week X 19 week X 2.5 hour/day X 0.095 L/km X 50 km/hour
= 1,015 L gasoline saved

To Convert to CO_2e:
= 1,015 L gasoline X 0.0023035 tonnes CO_2e/L gasoline
= 2.3 tonnes CO_2e

Energy Management for Town Owned Buildings Policy

LED Lights in Fire Hall
= (Estimated Incandescent Lighting Usage - Estimated LED Lighting Usage) X CO2e/kWh
= (30,476 kWh – 8,187 kWh) X 0.00082839 tonnes CO_2e/kWh
= 18.463 tonnes CO_2e

General Upgrades to Town Hall
= (2007 Furnace Oil Usage – 2011 Furnace Oil Usage) X CO_2e/L
= (7,305 L – 5,111.9 L) X 0.00268 tonnes CO_2e/L
= 5.878 tonnes CO_2e

LED Lights in Town Hall
= (Estimated Incandescent Lighting Usage - Estimated LED Lighting Usage) X CO_2e/kWh
= (28,695 kWh – 11,372 kWh) X 0.00082839 tonnes CO_2e/kWh
= 14.350 tonnes CO_2e

LED Holiday Light Exchange Program

To calculate reduced energy consumption:
= [(Load of String of LED Holiday Lights X Estimated Hours Used Per Year) X Number of LED Lights Given Out] - [(Estimated Load of String of Incandescent Lights X Estimated Hours Used Per Year) X Number of Lights Accepted]
= [(0.175 kW X 220 hours) X 192] – [(0.002 kW X 220 hours) X 96]
= 7,350 kWh

To Convert to CO_2e:
= 7,350 kWh X 0.00082839 tonnes CO_2e/kWh
= 60.9 tonnes CO_2e

Plastic Bags Initiative

Data retrieved from interviews with local grocery store managers and from Edwards and Fry 2011.
LDPE Bags can hold 7.96 items per bag resulting in 15 bags in total (since the bags are reusable)
HDPE Bags can hold 5.88 items per bag resulting in 19 bags/week which results in 988 bags/year

Foodland

= [Reduced emissions from fewer plastic bags] – [emissions from increase in reusable bags]
= [988 bags X (3,700 shoppers X 20% reusable bag users) X 0.000,017 tonnes CO_2e/bag] – [15 bags X (3,700 shoppers X 20% reusable bag users) X 0.000,105 tonnes CO_2e/bag]
= 11.30 tonnes CO_2e

Save Easy

= [Reduced emissions from fewer plastic bags] – [emissions from increase in reusable bags]
= [988 bags X (2,700 shoppers X 50% reusable bag users) X 0.000,017 tonnes CO_2e/bag] – [15 bags X (2,700 shoppers X 50% reusable bag users) X 0.000,105 tonnes CO_2e/bag]
= 20.61 tonnes CO_2e

Tree Canopy Initiative

To calculate above-ground biomass equation found in in Ter-Mikaelian and Korzukhin 1997 was used:
$M = aD^b$
Biomass = parameter a X diameter at breast height $^{\text{parameter b}}$
Parameters a and b are species specific. Where a and b values could not be found for an individual tree species an average for the genus were used. Where no species in the same genus could be located an average was taken across all tree species that were used for this inventory.
Only parameters that generated aboveground biomass could be found. To convert from aboveground biomass to total biomass M was multiplied by 1.26 (Nowak and Crane 2002).

To convert to total stored carbon total biomass was multiplied by 0.5 which converts the value into total stored carbon (Nowak and Crane 2002). Total stored carbon was found to be 1.211 tonnes.

To convert stored carbon into carbon dioxide:
Stored Carbon X Molecular Weight Ration of CO_2:C
1.211 tonnes C X [(12.01 C + 16 O X 2) / 12.01 C]

From this estimate GHG emission reductions were found to be 4.437 tonnes CO_2e between 2008 and 2012. This is approximately 1.109 tonnes CO_2e per year.

Zero Waste Enhancements

= Change in Methane released
= [(ΔDDOCmdecomp)(F)(16/12)-R](1-OX)

= [(Change in Amount Waste X Percent of Waste that is Organic) (Fraction of Gas that is Methane)(16/12)- Methane Recovered](1-Oxidation Factor)
= [(13 tonnes X 0.12) (0.5) (16/12) – 0] (1 – 0)
= 1.04 tonnes Methane

1.04 tonnes Methane X 21 CO_2e/ 1 Methane = 21.84 tonnes CO_2e

Appendix B: Greenhouse Gas Inventory Calculations

Solid Waste

$$CH_4\text{Emissions} = (CH_4\text{generated}_T - R_T)(1 - OX_T)$$

And

$$CH_4\text{generated} = (DDOC_m\text{decomp}_T)(F)(\frac{16}{12})$$

Where:

CH_4Emissions: The total methane emitted from organic material decomposing in an anaerobic environment.

CH_4generated: The total methane generated by organic material decomposing in an anaerobic environment. Through oxidation and methane recovery some of the methane generated may not be emitted.

T: Year for which the data applies.

R: Recovered methane.

OX: Oxidation factor is the fraction of methane that is exposed to oxygen in the top layer of waste and in therefore oxidized, reducing total methane emitted. In the absence of better data the oxidation factor can be assumed to be 0.

$DDOC_m\text{decomp}_T$: The amount of organic or decomposable material in landfill. The percent of organics present in the garbage stream (12.24), was used to calculate total organic material in the landfill.

F: The fraction of landfill gas that is composed of methane. The default is 0.5.

$\frac{16}{12}$: The molecular weight ratio of methane: carbon.

Since site-specific data was not available default values for the oxidation factor and amount of methane in landfill gas have been used. The landfill does not have any method for recovering methane. Therefore, this value was assumed to be 0.

Methane released: Baseline Year

= [(DDOCmdecomp)(F)(16/12)-R](1-OX)

= [(Amount Waste X Percent of Waste that is Organic) (Fraction of Gas that is Methane)(16/12)-Methane Recovered](1-Oxidation Factor)
= [(102 X 0.12) (0.5)(16/12)- 0](1-0)
= 0.816 tonnes CH_4

To convert to CO_2e:
0.816 tonnes CH_4 X 21 CO2e/ 1 Methane = 17.136 tonnes CO_2e

Methane released: 2011

= [(DDOCmdecomp)(F)(16/12)-R](1-OX)
= [(Amount Waste X Percent of Waste that is Organic) (Fraction of Gas that is Methane)(16/12)-Methane Recovered](1-Oxidation Factor)
= [(89 X 0.12) (0.5)(16/12)- 0](1-0)
= 0.712 tonnes CH_4

To convert to CO_2e:
0.712 tonnes CH_4 X 21 CO2e/ 1 Methane = 14.952 tonnes CO_2e

Appendix C: Survey

1. Please indicate which best represents your current living situation.
   ___ Annapolis Royal resident living in an apartment building
   ___ Annapolis Royal resident living in a house that I own
   ___ Annapolis Royal resident living in a house that I rent
   ___ Other (please specify) _____

2. How does your household dispose of your organic waste?
   ___ In the garbage
   ___ In a green cone
   ___ In the community collection bins
   ___ In a backyard composter
   ___ Other (please specify) _____

3. What is/are the biggest obstacle(s) in disposing of your compostable organic waste?
   ___ None - I am currently able to easily dispose of my compostable organic waste
   ___ A lack of information about where to dispose of these materials
   ___ A lack of facilities where I can dispose of these materials
   ___ The locations of the community green bins are inconvenient for me
   ___ Other (please specify) _____

4. On average, how many times per week does your household use a personal motor vehicle for travel <u>within</u> the Town of Annapolis Royal?

   _____

5. Which of the following town initiatives are you aware of? (Check all that apply)
   ___ Idling Control Policy
   ___ Invasive Alien Species Policy
   ___ Renewable Energy By-Law (By-Law to Permit the Production and Distribution of Energy from Specific Renewable and Green Energy Sources)
   ___ Zero Waste Initiative
   ___ Other (please specify) _____

6. Which, if any, of the following town initiatives have influenced your behaviour or habits? (Check all that apply)
   ___ Idling Control Policy
   ___ Invasive Alien Species Policy
   ___ Renewable Energy By-Law (By-Law to Permit the Production and Distribution of Energy from Specific Renewable and Green Energy Sources)
   ___ Zero Waste Initiative
   ___ Other (please specify) _____

7. Are you interested in installing renewable energy devices on your property?
   ___ Yes
   ___ No
   ___ I have already installed renewable energy devices on my property

   If yes, what is the main obstacle preventing you from installing renewable energy on your property?
   ___ Cost or purchasing and/or installing
   ___ Historical requirements of town
   ___ Logistic issues
   ___ Lack of time
   ___ Other (please specify) _____

8. What environmental initiatives would you like to see the town implement?

   _____

   _____

   _____

9. What energy source(s) do you use to heat your home and/or water? (Check all that apply)
   ___ Oil
   ___ Propane
   ___ Electricity
   ___ Wood
   ___ Other (please specify) _____

10. For the calendar year of 2011 how much fuel did you consume to heat your home and water? If you do not know how much fuel you use please estimate your cost of fuel per year.
    _____ Oil (in litres) or _____ in dollars
    _____ Propane (in litres) or _____ in dollars
    _____ Wood (in cords) or _____ in dollars
    ___ Other (please specify) _____

11. For the calendar year of 2011 how much electricity did your household use (please provide an estimate in kilowatt hours)?

    _____

12. If you would like to be entered in a contest to win a gift basket of energy efficient household items (e.g. light bulbs, water saving kit) please enter your email address or phone number.

    _____

Appendix D: Responses to the Question "What environmental initiatives would you like to see the town implement?" in the survey, sorted by category

LED Lighting

- Encourage private properties to join LED Lighting System
- Expand LED light system to school outside lights
- Ask bank of Nova Scotia to change spot light of back of building to LED Motion light as present light spoils possibility to star gazing and creates light pollution on board walk
- Install LED lights

Renewable Energy

- Put solar heat units of top of town buildings, schools, and municipal building
- Geothermal for heating/cooling in the new housing development behind SaveEasy (as a pilot project)
- Alternative Power
- Geothermal energy tapped from sewage treatment plant
- Increase the tidal power potential already in use as originally anticipated.
- Perhaps give assistance to those who are considering installing renewable energy devices in the choices, info, decision making and grant applications that is probably available. They have energy audits but perhaps a free service with simple tops e.g. unplug electric appliances when not in use, etc. to senior or others who feel overwhelmed by it.
- More solar power

Efficiency

- The town should be encouraging wooden replacement windows instead of plastic because they truly are more energy efficient
- Water efficiency programs
- Water consumption reduction programme
- Residential energy retrofit fund

Transportation

- Encourage walking instead of driving in Town
- Active and safe routes to school developed
- Ongoing support for public transit
- Campaign to have people walk within Town limits
- Promote ride sharing for out of town trips i.e. Halifax

Education and Outreach

- Tours of tertiary treatment plant – it's amazing natural technology – you should be proud and loud about it!
- Better promotion of Farmers' market and vendors (e.g. on the Town's website)
- Information about steps being taken to deal with the impacts of climate change on the town, and how citizens can be involved
- Get more information out about current initiatives (education and communication)
- Native vegetation promotion

Curbside composting

- Curbside collection of organic waste (e.g. Green Bin Collection)
- Curbside composting
- Green bin compost system where household waste is picked up. There is no way to compost when living in an apartment.
- Green bin pickup
- Rationalize/close green cone system and replace with green bins

Waste

- More garbage cans
- More recycling
- Collection of smoke detectors (which all have radioactive elements) with other hazardous waste.
- I wish I had a solution for people not using public recycling bins correctly. It's such a great idea, but as it is – a waste.

Misc.

- More outdoor activities organizing by the Town (e.g. skating, walking, better map of trails)
- More native species planted in green spaces
- Carpooling database for local/regional travelNight sky friendly lights for all buildings (public and private) and town can become a destination for night sky watchers!
- More enforcement
- Community compost garden
- Central neighbourhood heating
- Telephone wires underground
- Ban on grass burning (banned in Europe)
- Ban barrels for burning garbage
- Community Kitchen
- Community Gardens
- Reduce salt

- Pesticide ban
- Perhaps promote use of “green” products that don’t include toxic chemicals – for household, yard and personal use
- Light pollution by-law
- Urban chickens
- A community garden