

Municipality of the County of
Antigonish

Eco- Trust Basic Energy Audit Report

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1. Introduction

This Eco-Trust basic energy audit report is intended to describe findings from a basic walkthrough energy audit of the Municipality of Antigonish County's various assets. The object of this report is to identify opportunities to reduce energy consumption, and corresponding GHG (Green House Gases) emitted by various assets of the municipality of Antigonish County. The identified opportunities are to be listed and analyzed along with the energy inventory document previously prepared by the municipality for energy savings and green house gas reduction potential. The opportunities shown to be the most favorable are also listed in this and recommended for future feasibility study and potential implementation.

2. Methods

The assets of the County of Antigonish, are divided into the following categories:

1. Building Assets:
 - a. Antigonish Arena
 - b. Municipal Administration Building
 - c. Antigonish Court House and Detention Center
 - d. Municipal Works Building
 - e. Landfill Site Buildings
2. Vehicle Fleet, including light and heavy vehicles
3. Street and Area Lights
4. Water and Wastewater Assets

The structure of the report is also arranged according to the asset categories.

This report outlines the current findings of each site visit and an energy analysis of each asset, followed by a discussion of the opportunities determined for each asset. These opportunities are arranged into sub categories of housekeeping, minor capital, and major capital opportunities.

The house keeping opportunities are those that can be implemented through current operational procedures and/or maintenance practices. Minor or low cost capital items would include the upgrade or replacement of standard existing equipment using internal staff with assistance from maintenance contractors. Retrofit opportunities are those that require larger capital costs, outside contractors and coordination with building activities.

The opportunities described in this report are summarized in a spreadsheet located in the appendix of the report. This spreadsheet provides for each asset opportunity the expected savings in energy costs, the GHG equivalent emission reductions, implementation costs

and a calculated payback. The opportunity results are analyzed and sorted according to category and a proposed priority for implementation is assigned to each opportunity.

3. Executive Summary

In preparation for this report a site visit and walkthrough energy audit was made during the month of June 2008 to each building asset in the County of Antigonish as well as several sample water supply and wastewater treatment facilities.

The results of a previously prepared greenhouse gas inventory were also reviewed for energy consumption and asset comparison data. In addition to the building and water /wastewater assets the county's vehicle fleet and streetlight assets were reviewed for opportunities to reduce energy consumption

The assets reviewed for Antigonish County provided or 90 separate opportunities that were reviewed and listed in this report. Both new buildings including the municipal office building and older historic buildings such as the County Court house were reviewed and provided many opportunities for review. The Antigonish Arena is used extensively throughout the year, which provides several opportunities. A previous energy audit referred to as the I. B. Storey report provide input into several opportunities and background information on the arena.

This report captures the existing conditions for each asset including energy services, space heating and process loads and calculated a total energy consumption used by each asset. The opportunities provided for each asset are described in detail and a preliminary cost estimate provided to implement opportunities along with an estimated cost savings, and a calculated payback is also provided.

The appendix of the report lists in summary form each opportunity according to the order of the assets covered by the report. The opportunities are also sorted according to their category of opportunity and calculated payback for analysis and selection of the most promising opportunities. Another list sorts the opportunities with a suggested priority base on the analysis for each opportunity listed.

In general the opportunities identified are those that optimize the existing consumption of energy. Examples of this are for improvement in space heating of building assets where efficiency improvements to the furnaces and heat distribution are described. Heat loss reduction particularly through building envelopes such as the Antigonish County Court house floors, windows, and ceiling. Other opportunities identified opportunities for more efficiency where process motors are used such as pumps, blowers, and compressors are used in the arena and water and wastewater treatment sites these electrical motors and lighting fixtures are optimized to utilize more efficient equipment or deliver the same services. Where that service is required over a long period of time percentage of time the payback in the opportunities more attractive. The third type of opportunity is to reuse or

recover energy for reuse and supplementing the original fuel. The heat recovery from refrigeration equipment at the arena is a prime example of this.

Thirdly the use of alternative fuel sources by suggested use of a heat pump provides the same amount of space heating as comparable electrical or oil furnaces however its able to do it much more efficiently. Although a high capital cost t can use the heat in the earth to provide space heating and cooling to buildings. The municipal building is a good example of this where the heat pump can more efficiently replace fuel oil use for the existing boiler.

The opportunities described are in 3 categories. Internal staff can complete a house keeping opportunity. An opportunity to use regular service contactor to optimize energy usage existing equipment is described in the minor maintenance opportunities. Retrofit opportunities are those that require capital improvements and installation services to modify the assets to invest in lower energy consumption. The opportunities described are also prioritized and listed in the appendix of the report. Those opportunities described as eco-trust implementation are recommended for the next step of the Eco-trust program for detailed feasibility analysis. And are briefly listed below:

1. Antigonish Arena - ice plant heat recovery system
2. Heat pump application for maintenance building
3. Antigonish County Court House – building envelope heat loss reduction insulation and window replacement.

4. Building Assets

4a. Antigonish Arena

The Antigonish Arena is a single story recreational building of 1,720 square meters, it is owned and cost shared 50% each by the Town of Antigonish and the County of Antigonish. The arena's ice plant operates 11 months of the year, from September until the end of July. The arena is also used for the Antigonish County Exhibition during the month of August each year.

The Arena typically consumes 906,600 kWhr of electrical power annually, and 55,960 liters of #2 fuel (furnace) oil annually plus approximately 5,000 liters of propane for zambonie use. The total energy consumed is therefore 5,428,292MJ, representing an energy intensity level of 3,154 MJ/ m² or 3.14 GJ/ m². The I.B. Storey "Antigonish Arena –Energy Assessment" report completed in 2007 details a breakdown of energy for the arena.

Additional detailed audit findings, outside of the I. B. Storey report, on the equipment and systems reviewed during a walkthrough audit are as follows.

Ice Plant

The ice plant consists of two 60 HP “Cimco” refrigeration compressors which use ammonia refrigerant, along with a plate style chiller. A 30 HP brine re-circulation pump provides chilled brine solution to the slab under the ice surface. This equipment can be staged to handle the varying conditions of the ice surface. As the outdoor ambient temperature rises, as in summer months, the ice plant energy requirements also increase. The heat of compression and the heat removed from the ice surface need to be rejected from the ice plant. This is currently done with a BAC evaporative air condenser mounted at the rear of the arena above the boiler room. A single point Honeywell temperature probe, located in the ice surface slab, controls the ice temperature. The refrigeration lines and vessels are well insulated and neatly arranged. The plate heat exchanger replaced a former shell and tube heat exchanger, providing additional space in the compressor room.

The evaporative condenser water is circulated from a makeup tank to the condenser spray via a fixed speed 3 HP pump. The condenser fans are powered via a fixed speed electric motor estimated to be 3-5 HP.

The brine system is also used to remove heat from the compressors heat of compression and friction losses. This is done with a secondary glycol loop and plate heat exchanger with the brine system. This heat is then rejected to the air by the refrigeration condenser.

Heating system

An oil fired hot water boiler provides the Arenas space heating and flooding water heating. The boiler is a Volcano model 58-402-011HL 40 HP hot water boiler, formerly a steam boiler rated for 1675 MBTU /hr installed in the early 1980’s. The boiler has a “Reillo model F40” style burner with #2 oil firing capacity of 3.50 to 6.40 gallons per hour. Four hot water circulating loops distribute hot water from the boiler to the various heat loads in the arena.

The most significant hot water heating load is the domestic/flooding hot water system. There are two (120 gallon) indirect heated hot-water tanks located in the mechanical room that provide both ice flooding water as well as water for showers. These hot water heaters operate on a thermostat with their own circulating pump system. The other heating loads are used for the heating of the dressing rooms and common spaces. This is accomplished by 3 other hot water zones each with a circulating pump controlled by a zone thermostat and an on/off switch in the boiler room. There is no current thermal heat storage system in the arena

Arena Lighting Systems

The arena ice surface is illuminated by metal halide lighting fixtures fitted with a dimmable control panel used for setting various levels depending on the function. The area over the bleachers and stadium area are incandescent lights. T12 fluorescent fixtures illuminate dressing rooms, corridors, and office areas. A new program by Conserve Nova Scotia has attractive incentives for lighting system audits and upgrades.

4a. Opportunities –Antigonish Arena

Housekeeping Opportunities

1. Cleaning of light fixtures annually and group re-lamping (when required) at the estimated end of life of the lamps can provide a minimum of 15 percent improvement in light. In Antigonish Arena's case a lower dimming level may be used saving approximately \$600 per year. The payback on this investment is 3 years.
2. Replace drive belts with more efficient v-notch belts.
Replace compressor drive belts and condenser drive belts with more efficient v-notched belts, for approximately 1 % better efficiency and lower cost for belts. A 1% savings on the ice plant is calculated as $1\% \times 120 \text{ kW} \times 4000 \text{ hours} \times \$0.10 = \$480$ per year the cost of replacement belts is assumed to be approximately \$250 this represents a 6 month payback.
3. Replacement of incandescent lamps as listed in the Storey report, item 8. The estimated cost of replacement is 1000 and savings \$700 with a pay back between 1-3 years. Also refer to Conserve N.S. lighting incentive.

Minor Maintenance Opportunities

1. Insulate all hot water supply and return lines in boiler room and hot water distribution system. Anticipated savings may be up to 5% of boiler efficiency or \$1,300 annually. Cost of insulation is \$2,500 representing a 2-year payback.
2. Boiler fireside surface maintenance to check for and remove sooting, clean buildup of deposits, and repair insulation damage. This may improve boiler efficiency 3-5%, saving approximately 1,200 liters of fuel and approximately \$1,200 in cost per year. The cost of this service is estimated to be \$1,000 therefore a 1 year payback
3. Boiler burner maintenance is a reoccurring task where burner efficiency is monitored at least 2 times per year. The efficiency measurements can be tracked and an optimum maintenance schedule put in place. This type of maintenance can result in a boiler efficiency improvement of 1-3%, also saving approximately \$1,200 per year with an annual payback of less than 2 years.
4. Relocate the oil tank to indoors to improve fuel efficiency. Each liter of fuel requires heat to raise temperature from ambient to ignition temperature. Installing the oil tank indoors recovers the heat from the boiler room and improves the quality of fuel, as well as increases the life of the fuel tank. It is estimated that the annual total of 27,000 liters of fuel could capture over the year an average of 20 dg C, resulting in a savings of 100 liters per year of fuel. The costs for relocating and housing an existing tank are expected to be \$2000 therefore resulting in a

- long pay back of over 20 years, however in the event of a fuel oil tank replacement this may be considered.
5. Replace the locker room lighting controls with individual occupancy sensors, switch type. Savings of 30% of electrical consumption costs are available. Assume usage of 2000 hours per year and typical load saving of \$150 for dressing rooms. The cost per installation is \$100 therefore a 4 year payback.
 6. Replacement of exit lights with new LED style is underway. Refer to Conserve Nova Scotia's lighting upgrade program

Retrofit Opportunities

1. The ice plant refrigeration system rejects significant amounts of heat to the air via the evaporative condenser. This heat can be recaptured with a water-cooled condenser to recover as much heat as possible. This heat can then be used to offset the oil used by the boiler to supply the domestic hot water heating system, which is generally in use while the ice surface is being used. This is described in the Storey report, item 1. A thermal heat storage system capable of storing the heat produced by the ice plant will allow the heat to be used more effectively throughout the day or possibly for a few days, depending on capacity. This is described in the high efficiency heat recovery opportunity in the Story report. A high efficiency ice plant heat recovery system is estimated to cost approximately \$220,000. The estimated savings by using this type of plant are reported to be about \$24,327 per year. Therefore this project has a calculated payback of 9 years.
2. During low temperature outdoor weather when temperature and humidity conditions are acceptable free cooling (outdoor air) may be used to maintain the ice surface temperature rather than the ice plant. This measure is described in The I. B. Storey report as item 2. The estimated cost to implement is \$2,100 and the annual savings are estimated to be \$651, therefore the calculated payback is 3.2 years.
3. Add a de-superheating heat reclaim system to the ice plant. This would be an interim step to a larger Eco-chill project, which described further in the I.B. Story report. The cost of a de-superheating heat reclaim system is \$25,000 and the expected savings are about 9,200 or a calculate payback of 2.7 years.
4. Reduce electrical motor load consumption with variable speed drives.
 - a. Add a variable speed electric drives on the 30 HP brine re-circulation pump to vary the coolant flow (pump speed) according to temperature demand. Reduced load requirements for the ice surface can reduce the speed of the brine pump. Reducing speed of a pump will reduce the electrical consumption of that pumps motor. Therefore installation of a variable speed drive controlled by the temperature measurement may

- provide a savings of 25% load or $30\text{kW} \times 6,000 \text{ hours} \times 25\% \times \0.10 per kW which represents a savings of \$4,500 per year. The installed cost of a 30 HP variable speed drive is estimated at \$9,000 resulting in a 2.0 year pay back. This opportunity depends on the ability of the brine re-circulation pump to be speed modulated and may be used in conjunction with a temperature control opportunity.
- b. Add a variable speed drive as suggested by the Storey report for the evaporative condenser fan. The cost is \$5, and the annual savings estimated at \$1,490 for an annual payback of 2.3 years
 - c. Add a variable speed drive on the 3 HP condenser, evaporative water pump. Similar to the example of the evaporative fan assuming 25% of the consumption can be saved. This represents $3 \text{ kW} \times 25\% \times 6000 \text{ hr} \times \$0.10 \text{ kWhr} = \$450$ saving per year. The cost of a variable speed drive installed, is estimated at \$2000 with a payback of 4.4 years.
5. Improve the efficiency of compressor motors. The compressor electric motors are standard efficiency and have been rewound. Since the motors are used for a significant period of time through the year, new premium efficiency motors could replace these motors, with an expected efficiency improvement of 6-8%. This also applies to the remainder of motors such as the brine pump, condenser pump and condenser fans. A savings of 5% on efficiency for the compressor motor represents potential electrical savings of $5\% \times 60\text{kW} \times 6,000 \text{ hrs} \times \$0.10 \text{ kWhr} = \$1,800$ per year. The cost of a high efficiency 60 HP motor is \$4,200 therefore a simple payback of 2.3 years can be expected.
 6. Reduce the ice surface heat gain by adding insulation to the roof. The temperature difference between the inside and outside particularly during summer operation adds a considerable load to the ice plant. External insulation should be added as part of a roof replacement plan, at an additional cost of approximately \$20-25 per square meter or approximately \$50-60,000. This will save the ice plant from working as hard in the summer. The estimated heat gain is estimated using a temperature difference from outside to inside of 25 deg C, 38 mm rigid foam has RSI value of 1.053 or a U value of 0.949 W/(m² x deg C) therefore for a ceiling of 2000 m² the heat gain per hour is $Q = U \times A \times (T_1 - T_2) \times 3.6 \text{ kJ/hr} = 170,940 \text{ kJ/hr}$. At a peak cooling would reduce the electrical consumption of the ice plant by 12kw per hour. Based on operation for 4,000 hours over the season this represents a savings of \$4,800 annually therefore a payback of approximately 10 years.
 7. Optimization of the boiler sizing. Consider replacement of the larger single boiler with two or more smaller hot water boilers, capable of handling the systems maximum demand, and the ability to be modulated to provide summer demand for domestic hot water, or work in conjunction with the heat recovery system. Rational is to prevent the large boiler from cycling on and off, thereby reducing

8. For cost savings of demand peaks consider using power factor correction capacitors on larger motors. Estimated cost of installing power factor correction capacitors on ice plant motors is \$4,000. The expected savings are estimated to be \$2,000 per year for a calculated payback of 2 years.
9. Reclaim heat from step down transformers in electrical room. Approximately 3% of transformer capacity is heat loss and can be used to heat common areas.
7. Reclaim heat from the compressor room by exhausting through HRV to common spaces.
8. Add a centralized energy management system to control individual zones, as suggested by the Storey report item 4. The estimated installed cost is \$9,000 and the savings expected are \$2,000 per year for an annual payback of 4 years.
10. Add an ice surface temperature control system to select the optimum operating temperature as described in the I.B Storey report. The estimated cost of this system is \$25,000 and the estimated savings are \$5,800 annual for a calculated payback of 4.3 years.
11. Recover heat of compression and friction losses in the refrigeration system currently rejected to the outdoors. The small plate heat exchanger and the secondary glycol loop from the compressors used to cool compressors may be used to indirectly heat or preheat the domestic/flood water tanks in the compressor room by adding a second heat exchanger.

4b. Court House & Detention Center

The Antigonish County Court House is a 2 story, wood frame, historic building, originally built in 1855. The Antigonish Detention Center also an older building is a stone and cinder block building attached to the courthouse on Court Street in the town of Antigonish. The detention center is 3 stories in height including the basement. The total combined area of the buildings is 609 square meters.

The buildings have a combined electrical service supply and heating system. The total annual electrical consumption is 165,840 kWhr and total annual oil consumption is 25,271 liters. The total energy consumption is therefore 1,251,000 MJ, and the energy

intensity is calculated as 2,054 MJ/m². This represents an average energy intensity of 2.0 GJ/ m², which compares relatively high for the average commercial building at 1.6 GJ/ m².

The electrical service is from the Town of Antigonish power utility at 3 phase 208 volts and is provided with a back up diesel generator. An electric hot water heater with an 80-gallon tank provides domestic hot water.

The heating system is via a low-pressure (15 psi) oil fired, fire tube steam boiler. This boiler is located in the basement of the detention center. Steam heat is transferred to hot water via a heat exchanger, and distributed by fan coil unit heaters to the detention center. Fin tube steam radiators and convectors heat the court house. Steam is piped to the court house, condensate is returned to the boiler house by a separate pipe. The radiators and convectors in the adjacent side rooms and judges chambers have a thermostatic control valve to control individual room heat. A single wall mounted thermostat controls the main courtroom. A separate thermostat, located in the judge's chambers, also can call for heat. The entire court house is a single steam heating zone and is isolated by a zone valve in the boiler room.

The boiler room is quite small with a minor amount of combustion air make up. The boiler room also consists of the electrical room. The fuel oil tank is located underground behind the detention center.

The courthouse meeting room and judges chambers are provided with supplementary split system, air conditioners (Mitsubishi –Mr. Slim) that are not currently configured for heat pumps.

The insulation on the courthouse building was found to be minimal with no insulation in the floor of the courthouse. It is understood from maintenance personnel that there is little insulation in the walls as well. The steam and condensate piping insulation is missing in some areas and insulation may consist of asbestos material.

The windows in the courthouse are quite large with approximately 60 square meters of rough opening window space. They all appear to be double glazed but unsealed windows, with a large ¾" air space inside the two panes of glass.

The electrical lighting is generally by T-12 fluorescent fixtures, supplemented with natural light in the courthouse.

4b. Court House - Opportunities

Housekeeping Opportunities

1. Replacement of incandescent lamps with compact fluorescent lamps.
2. Check the boiler water /steam side chemicals verify the blow-down schedule and chemical concentration, and possibly treat and remove scale from wet surfaces to

improve heat transfer. This will provide a 2% improvement in fuel efficacy saving \$500 per year and has a payback of 2 years.

Minor Maintenance Opportunities

1. Install insulation on all steam supply and return pipes as well as condensate receivers. The steam piping below the floor of the court house is not insulated. Pipe insulation can reduce losses up to 3% saving approximately 800 liters of oil or \$800 per year in costs. The cost to add or replace or re-cover insulation is estimated at \$ 3,000 (if asbestos is present removal costs could be extra) and therefore this project has a payback of 3.75 years.
2. Upgrade the boiler lagging and insulation to reduce boiler radiation losses. This may be done in conjunction with the pipe insulation work. Assume a savings of 1.5% efficiency improvement or 500 liters of oil or \$500 per year.
3. Install a separate heating zone for the judge's chambers to allow a call for heat with out involving the entire court house. This will provide for significant savings in usage of the court house heating system estimated at 15% savings on oil. Saving = $15\% \times 25,271 \text{ liters} \times \$1.00/\text{liter} = \$3,790$. The estimated cost of modifying the heating zone is 2,500. This has less than 1 year payback.
4. Install an easily identified boiler summer season shutdown selector switch system. This can save use of fuel during mild weather. Savings of \$800 per year and cost is \$300 to install therefore less than one-year payback.
5. Install a larger fresh air makeup system to the existing boiler. This will help to prevent build up of soot where insufficient air may be present. Review boiler fireside cleanliness to remove soot and material on fire side surfaces. This will provide a 3% -5% improvement savings potential of \$800 per year and a 2 year payback.
6. Verify if the existing Mitsubishi "Mr. Slim" split air conditioners, used in the court house meeting room and judges chambers can be upgraded to heat pumps. This may only require a new control board or installation of a reversing valve. If it can be converted to heat pump this will save \$4,000 per year in heating costs and could have as little as a 6 month payback.

Retrofit Opportunities

1. Install an energy management system to monitor spaces and control actuators. This will allow building spaces to be checked and modified as required for varied use, scheduling and programming. An estimated 5-10% savings in fuel oil consumption can be achieved with a new monitoring system. The savings are calculated to be \$2,500 per year. The cost for a basic system is \$5,000; therefore the payback is 2.0 years.

2. Install a heat recovery ventilator (HRV) in the boiler room to recover heat lost, and utilize the recovered heat inside detention center as fresh air make up air in winter. The estimated cost of ductwork modification and HRV equipment is \$3,000. The potential savings on heating system fuel is approximately \$700 per year. This project has a 3.4-year payback.
3. Consider running two smaller boilers in boiler room to provide smaller size for shoulder season use. The existing boiler is not modulated and therefore needs to cycle during winter. This may be more easily installed by a new boiler room at surface in the parking lot, complete with internal oil tank and hot water heating system. Cost of replacement is estimated to be \$30,000, savings on energy is estimated to be \$3,000 per year, this project is a 10-year pay back.
4. Convert to hot water distribution in courthouse, similar to the detention center. As part of hot water conversion a change to an in-floor radiant hot water system with an upgrade to floor insulation. Thermal mass may also be installed in the floor of the court house. It is estimated that the cost to upgrade to in-floor heating \$8,000 - \$10,000. The energy savings is expected to be approximately 15-20% or approximately \$3,750 year. Therefore this project has a 2.5 year payback.
5. Improve heat loss through windows by using sealed double or triple glazed glass, also consider reflective film to reduce heat loss in winter and reduce heat gain in summer on south side. The window to wall area ratio in the court house is quite high. The total window area is 60 square meters. Replacing the windows with a premium triple glazed window would save the equivalent of 32,832 kJ/hr on the coldest design day. This represents an annual cost savings of 1,800 liters of fuel or \$1,800 per year. The cost of installed windows is estimated to be \$400 per square meter or \$24,000 the payback is approximately 12 years.
6. Insulate the ceiling and all spaces of the court house. As well insulate the interior side of the exterior walls in the detention center and install built up roof insulation during the next roofing retrofit. This work is expected to save approximately 30% of the heat loss in the building and represents a savings of \$8,000 per year. The cost of ceiling insulation is estimated to be \$20,000 and the cost for net wall perimeter 162 meters insulation is expected to be \$30,000. The project payback is therefore 6.25 years
7. Consider an air source heat pump with an air or glycol load for shoulder season heating and summer cooling of the courthouse. This could be a split system, with the compressor section mounted outside on the ground or roof top unit. A heat pump uses an electrical source and is approximately 300 % efficient over electrical heat and equivalent oil heat. Unfortunately during the cold weather the heat pump efficiency drops off and a back up heat source must be used. The estimated cost of a heat pump system of 10-ton unit is \$15,000 installed. The cost of a glycol distribution system is estimated to be an additional \$12,000 therefore total installed cost of \$27,000 the cost savings are estimated to be =

50% operating hours x 66% efficiency savings x 35% (court house area) x 25,000 liters fuel = 2,887 liters or approximately \$3,000 savings. The project payback is therefore 10 years.

8. Court House lighting and controls

Lighting opportunities include replacement of lighting with more efficient lamps such as LED for exit lights, since these are on continuously. The court room and office overhead lighting should be upgraded to T-8 or T-5 fixtures with electronic dimmable ballasts. The courthouse has high ceilings and will require HO (High Output) ballasts. The presence of large south facing windows as well as windows on all sides will allow for a large amount of natural light. Daylight harvesting controls can provide a savings since most court proceedings and building use is during daylight hours.

The lighting in the detention center is on for significant periods of time therefore the lighting fixture upgrades in this area should be as efficient as possible, with compact fluorescent lamps and replacement of fluorescent fixtures with T8 or T5 lamps, and electronic dimmable ballasts. Fixtures in less occupied areas can have occupancy sensors added. It is expected that 30% of the lighting energy can be saved annually. This is approximately \$300 per year in savings. The cost of replacement fixtures is estimated to be \$4,000 therefore this is a 10-12 year payback.

A new lighting program by NSPI and Conserve Nova Scotia will provide a lighting audit and recommended replacement fixtures at an attractive, approximately 20% cost. This reduces the payback to a 1-2 year period

9. The light and exhaust fan controls in the washroom at the courthouse should have its switch replaced with an occupancy sensor. This will ensure light is on only while occupied and avoid inadvertent exhausting of heated or cooled air as well as the light being left on.

4c. Municipal Administration Building

The Municipal Administration Building is located on Beech Hill Road. This is a single level building built on a slab. The building is divided into two main sections, the west section, with approximately 60% of the space houses the administrative offices for the County. The east side of the building contains the County's council meeting chambers as well as a large conference room and utility room. There is an open circular center section joining the two sections, with two service counters. The administration section of the building operates about 2,500 hours per year and the council chambers and meeting room are used periodically. The central gallery is the main entrance and service area for the building and is also used about 2,000 hours per year.

The building is relatively new having been built in the year 2,000 with current materials and building standards. It has an overall area of 954 square meters. The building used 17,992 liters of #2 fuel (furnace) oil in the most recent year, and 109,560 kWh of electrical power over the same period. The total energy used was therefore 1,090,346 MJ and the energy intensity is calculated at 1,142 MJ/ m² or 1.1 GJ/ m². This is considered favourable compared with Atlantic Canada's average energy intensity of 1.6 GJ/ m².

The building's space heating requirements are met via a steam boiler with a "Reillo F40" non modulating burner, rated for 7.0 GPH of #2 furnace oil. The boiler steam is converted to a hydronic (glycol heating system) via a plate type heat exchanger and provides heat distribution throughout the building via under floor in-slab radiant heating tubes. A hot water indirect heating system and storage is installed in the mechanical room. Two air-handling units are located on the roof of the building and provide fresh air make up to each of the building spaces. The air handling units have both a refrigeration air conditioning air coil and a tempering heating air coil. The heat and air conditioning systems are monitored by a building energy management control system.

"Sustainable Housing & Educational Consultants" conducted an air leak-testing audit for the building in 2005. Some remedial air barrier and insulation was added in the common gallery circular area as well as administration area. Some comments of cool walls and drafts have been received from recreation offices located on the north side of the building. The report identified the measured air exchange rate at 5.4 air changes per hour that is considered high for this type of occupancy and costs extra to heat and cool.

The main electrical loads are the air handling system fans, (each a 3HP belt driven drive), the circulating pumps in the boiler room, and the air conditioning compressors on the roof top. The domestic hot water is indirectly heated by the glycol system.

The lighting in the administration building is up to date with compact fluorescent fixtures in pot lights and wall sconces. Overhead lights in the office areas are T-8 fluorescent with electronic ballasts.

4c. Main Administration Building - Opportunities

Being a relatively new building with modern mechanical and electrical systems there are a much smaller number of opportunities.

Housekeeping Opportunities

1. Ensure steam boiler operations as efficient as possible with water chemistry checks, periodic blow down and inspection of fire side surfaces for soot and build up. Also burner and burner efficiency checks. Regular maintenance of these items will help to improve boiler efficiency up to 10% for a savings of 5-10 % x 18,000 liters = 1800 liters or approximately \$1,800 per year. The annual cost to

complete these checks are \$800 annually therefore a simple payback of 6 months each year.

Minor Maintenance Opportunities

1. Complete the sealing and insulation of vapour barrier to reduce the amount of air exchanged in the building as suggested by the "Air Leakage Testing" report. Each air change per hour for this building is approximately 589 liters/sec of infiltration air. An airflow rate of 500 liters/sec of infiltrated air costs requires 1,800 liters of fuel or \$1,800 per year. The cost to seal the air leakage is estimated to be approximately \$2,000 therefore this project has a 1-year payback.
2. Consider window coverings and orientation of persons with the windows on the north side (recreation) area of the building to minimize radiant heat losses. The estimated cost for 10 windows is \$1,500 and savings of \$200-300 annually for a payback of 5-6 years.
3. A lighting system upgrade may be possible using slightly better fixtures as per the Conserve Nova Scotia program however current lighting fixtures appear to be of high efficiency.

Retrofit Opportunities

1. In order to replace or offset oil as the space heating fuel with a more efficient source, a heat pump system should be considered. An air source heat pump system can be used to supplement the existing boiler during shoulder seasons but the furnace will be required during extremely cold weather. The existing space heating under floor distribution system can be used with a heat pump. The capital cost of a source heat pump system heat pump is high, however an air source heat pump is 2.5 - 3 times the efficiency of a comparable electrical or oil source system. The estimated cost for a single 25-30 ton or (three 10 ton) air source heat pump system with hot water load side is \$30,000. The annual savings, based on a COP (coefficient of performance) of 3.0, and use over 60% of the heating season is estimated at 18,000 liters x .70% x (1-.33) efficiency factor = 8,316 liters of oil or \$8,500 Therefore a project payback of 3.5 - 5 years.
2. A ground source heat pump has considerably more capital cost depending on an open or closed ground heat exchanger system. A ground source heat pump provides better performance with the COP value of 4-6 times the equivalent electric for oil fired boiler. A horizontal closed system requires surface area, which is available at this site. Assuming 137 m² per ton of ground source heat exchanger pipe the estimated cost of a ground source system is \$1,200 per ton or \$36,000 plus the heat pump cost of \$30,000 for a total capital cost of \$66,000. The ground source heat pump can displace most of the fuel oil however the cost of electricity is still required. The COP of a ground source pump is higher at 5.0 therefore the cost of running heat pumps annually is \$5,000 for equivalent heating capacity

therefore savings are estimated to be $\$18,000 - \$5,000 = \$13,000$ per year. The project payback is therefore 5.0 - 7 years

3. The existing roof top air handling systems should be verified to determine if they can be modified and operated as air source heat pumps to provide heating.

4d. Landfill Site Buildings

The municipal landfill site is located at the top of Beech Hill Road. The site operates a scale house for metering solid waste, which is collected by county garbage trucks delivered to the site and then transferred by tractor-trailer to the solid waste facility in Guysborough County. A second process located at the site in a separate building, collects and separates recyclable materials into cardboard and paper, or into a plastics, metals, and glass trailer section. These materials are transferred to the bale fill site in Colchester County via a transport trailer truck. The landfill receives construction and demolition wastes which are land filled and receives compostable materials that are composted.

The site has several years of operation as a previous domestic waste landfill site and a program for testing and potential collection of landfill gas is being considered.

The buildings at the land fill consist of the following :

1. New scale house (Former scale house removed).
2. Transfer building for recyclables.
3. Maintenance and mobile equipment shop.
4. Settling pond pump house and Treatment building (no longer in use).
5. Compost building cover and structure (no energy loads)

Description of Buildings and Energy Audit Findings For Landfill Site

1. The scale house is a small building, recently installed in approximately 2006. It is approximately 12 square meters in area. This building contains a station for an attendant to record incoming and outgoing gross and tare vehicle weights to landfill. It has its own electrical service and is heated via electrical baseboard heater. Controls for the truck scale are housed in this building.
2. The recyclables transfer building is a single story, 4m high, building built on a operating level slab, with lower section to receive a transport trailer. The trailer is divided into the paper storage compartment, and a second plastic, glass, and other metals compartment. The operating slab area is used for collecting and sorting recyclable materials. A small excavator is used in the sorting and handling process.

The electrical service for this building is a single-phase 100 amp, 240/120-volt, service. This building has low-pressure sodium outdoor lights controlled via photo

cell, as well as eight 400 watt metal halide indoor lamps. There is no space heat used or required in this building. The building is comprised of a steel frame, with non-insulated (except for the roof) steel siding. There are a few translucent panels on the north side.

The lights are normally left on in the daytime and it was noted that the outdoor lights were on indicating a photo cell problem, likely from dirt or needed adjustment. The scale house and the transfer building are located approximately 40 m apart.

3. The landfill maintenance shop is a single story building, 4m high, with two large bay doors. It is a wood structure building with steel siding and assumed insulated with plywood interior wall heating. A services room and operator lunchroom is located on the east side of the building. The electrical service for this building is a 200 amp, single phase 240/120 volt system. The lights in the building are comprised of five 8-foot two-tube, T-12 fluorescent tubes. The heating of the building is via two electrical forced air (25 KW assumed) unit heaters in the shop areas, with electrical baseboard heaters in the tool room and lunchroom. Other electrical loads include basic lunchroom appliances, a hot water heater, shop air compressor, and utility tools. There are no yard lights fed from this building.
4. The settling pond building is a small 10 square meter building over a manhole that contains a submersible 10-20 HP lift pump. The building contains a polymer make down and mixes tank, a metering pump, and storage for "Klear Aid" (currently 4 drums) polymer. The building contains an alarm system and a 10 KW electric space heater. The building is no longer in use, the pump is removed from the wet well and the door to the building is missing, however the electrical power is still connected and the heater controlled by a thermostat

4d. Landfill Site Building - Opportunities

Housekeeping Opportunities

1. Disconnect the power to the settling pond building and remove any electrical components that are salvageable. The distribution panel is currently switched on and energized. The existing heater is on a thermostat and may still be consuming power during cold weather. The local NSPI transformer is still providing transformer losses and contributing to line side losses as well as meter minimum monthly costs of approximately \$200 annually.

Minor Maintenance Opportunities

1. Repair of the outdoor photo eye to automatically turn yard lights on/off according to ambient lighting conditions. The building is in a secure area; therefore security lighting during nights may not be necessary.

2. Add translucent panels to the back (south) and east side of the transfer building around the trailer loading area. The lighting level of the building with the doors open provides sufficient light to operate. Natural light during the spring and summer season, and most daylight operating hours will provide the necessary lighting. The cost of the translucent panels and installation is estimated at \$1,600 the estimated electrical cost savings are $8 \text{ lamps} \times 400 \text{ watts per lamp} \times /1000 \text{ watts/kW} \times \$0.11 \text{ kWhr} \times 1,400 \text{ hours} = \500 per year. The pay back is therefore calculated at 3.2 years.

Retrofit Opportunities

1. Replace the lighting in the maintenance building with T8 fixtures and electronic ballasts. The fixtures in the maintenance shop are prone to being left on while employees are out in the site. An occupancy sensor would allow a portion of the fixtures to automatically turn off after a time period of no occupancy, and to turn on when sensing occupants. The windows and large bay doors in warm weather provide significant day lighting. Therefore a daylight controller and dimming ballast may reduce the lighting load.

The potential savings on $8 \times 5 \times 200 \text{ watts} \times 2000 \text{ hours} \times \$0.11 / 1000 \text{ watt/kW} = \$1,760$ at 30 % savings or \$500. The cost to replace such fixtures is estimated to be \$3,000 for an effective payback of 6 years. The new Conserve Nova Scotia lighting program will audit and replace these fixtures with only a 20% cost increasing the potential payback to less than 2 years.

2. Although not an energy saving measure the cost of electrical service may be reduced by installing a sub feeder from the transfer building to the scale house, or vice versa. The estimated cost is $\$20 \text{ per meter} \times 40\text{m} = \800 . The savings are calculated at $\$15 \text{ per month} \times 12 \text{ months} = \180 , pay back is 3.3 years.
3. The hot water tank at the maintenance building is a 3KW unit; the storage losses for a non-insulated tank may be eliminated with an instant on inline water heater. Hot water is only used for sanitary purposes. The estimated installed cost is \$600 for the appliance. The anticipated savings are $10\% \text{ of } 3\text{Kw watts} \times 8,000 \text{ hr/year} \times \$0.11 \text{ kWhr} = \$264$ per year. Therefore the simple payback is estimated at 2.2 years. A similar opportunity exists at the scale house since it contains a single washroom with a small electric hot water heater.
4. Methane capture and incineration.
The biomass in the existing landfill site begins to produce useful amounts of methane gas after only a few years of decomposition. Maximum production of methane gas of 1 cubic meter of gas per hour occurs for each 1,500 tonnes of waste land-filled, over the next 20 –30 years. Methane gases that are left to escape to atmosphere will contribute approximately 21 times the GHG equivalent of methane combusted or flared. Methane collected and compressed can be used to fuel a gas turbine, which in

turn can produce electricity as well as heat as a by-product. The cost of a gas turbine is approximately \$1,000 – \$1,500 per KW. The amount of energy used by a gas turbine from a cubic meter of methane is .0372 GJ or approximately \$0.58 per hour or approximately \$5,000 per year. Approximately 40% of this energy can be recovered, as generated electricity using a gas turbine. The waste stream is hot air that can be used for other process use such as compost production or space heating. For example a landfill with 100,000 tonnes of waste can generate 100,000/1,500 tonnes x 60% recovery factor .0372 GJ x 277 kW/GJ x \$.06 kWhr x 8000hours = \$197,880 per year revenue. The capital cost of a 600 kW gas turbine is approximately \$600,000 plus the cost of a collection and compression station assumed to be \$500,000. The estimated payback is therefore 5.5 -7 years assuming the production quantities of methane are available.

The methane product can also be compressed into bottles and used to fuel vehicles. The conversion of a standard light vehicle to run on natural gas is \$3,000.

This type of project reduces potential green house gases and at the same time produces energy. It works best when both thermal energy as well as electricity is co-generated. There are concerns with the potential gas emissions from combusting or flaring land fill gases that need to be considered. I understand that a study may be underway to determine the feasibility of landfill gas recovery.

5. The C&D (construction and demolition waste) contains significant soft wood and combustible material. Approximately 2 tons of combustible wood waste is equivalent to a barrel of oil. Although this opportunity is beyond the scope of a walk through energy audit, requiring sufficient quantities of C&D waste or other combustible waste and a suitable material handling system. The ability to separate or process C&D waste and fuel a steam generation process could drive a steam turbine and produce electricity.

A waste fueled system in the 1 MW range could generate approximately \$360,000 revenue per year. The former Sydney Incineration Plant system was a 2MW for a reference size. A 1.0 MW system may be considered the minimum viable size unless a steam requirement was needed. Assuming the combustion and generation efficiency of a steam plant for electrical generation is 25%, the required fuel load for 1 MW production requires approximately 1,000 tonnes per hour. The anticipated cost for a steam co-generation plant of this size is estimated to be approximately \$3,000,000; the anticipated payback is approximately 10 years. As the cost of land filling material and the cost of electricity increase this type of project becomes more attractive. The current amount of fuel available is not considered feasible for an optimum sized system.

A project this size would also provide significant amounts of waste heat that may be useful in allied processes. The waste reduction would reduce the landfill volume and decomposition of methane gas from decaying wood. This project may also be considered in conjunction with methane capture and gas turbine waste heat to assist

with the combustion efficiency. There are however serious pollutant gas emissions with this type of process. There are current technologies to mitigate the pollutants that need to be considered as well.

4e. Municipal Maintenance Building

The County of Antigonish maintenance or works building consists of a leased building space located at Locharbour road. It is sized at 604 square meters, and approximately 4m high with two truck doors on the east end and 5 truck doors on the north end. The building consumes 24,040 kWhr of electricity and 19,176 liters of #2 fuel (furnace) oil annually and has a total energy use of 828,271 MJ and an energy intensity of 1,371.3 MJ/m².

This building contains the County's heavy vehicle fleet assets including the garbage trucks, waste recycling trucks, public works vehicles, spare parts and maintenance equipment. A new replacement maintenance shop is scheduled for construction this year (2008), at a new location on Beech Hill road.

The existing maintenance shop is divided into two areas. On the north side is a two-bay shop used for the recycling collection trucks. On the south side with doors opening to the west, are five overhead large doors for the heavy mobile equipment. A wash bay exists at the southern most truck bay. A row of windows exists at the west or backside of the building. A small office area exists in the center of the building and a small furnace room on a mezzanine floor. This building because of the number of overhead doors and large space has considerable infiltration of outside air requiring additional furnace load.

The maintenance shop is provided with a 3 phase, 208/120volt, 200 amp electrical service, The lighting is generally with approximately sixty 8 foot fluorescent T-12 fixtures and magnetic ballasts in 2 tube light strips. Typical electrical loads for the building include an electric hot water heater, an air compressor and supplemental electrical heat for office space. Fuel oil is stored in two 200-gallon outdoor tanks located on the north side of the building. The floor is a concrete floor.

The space is heated with two Lincoln furnaces, rated at 315,000 BTU/hour each with burners rated for 2.50 gph. One furnace provides overhead hot air distribution to the east side shops, and the other to the north side. Each furnace has a separate burner fan and distribution blower. Fresh air is provided to the mezzanine furnace room from outside air ducts directly to the furnace room.

4e. Municipal Maintenance Building Opportunities

Housekeeping Opportunities

1. Routine maintenance on the furnaces to maintain furnace and burner efficiencies. Expected savings of 5% of heating costs or \$5,000 per year and a 6-month payback.

Minor Maintenance Opportunities

1. A lighting upgrade would be recommended if the building was going to be maintained. This upgrade could fall under the Conserve Nova Scotia Program.
2. The addition of sky lights and natural lighting panels to assist with supplementing electrical lighting. Southern exposure walls with an overhang to protect from summer heat gain. Indirect lighting may also be obtained from roof monitors. The estimated cost of this system is \$6,000 and savings of \$800 per year for a calculated payback of 7.5 years.
3. A hot air system ceiling de-stratification fans could be considered to increase comfort at the working level. The cost of fans and controls is estimated to be \$5,000 and the expected savings \$1,000 per year for a calculated pay back of 5 years.

Retrofit Opportunities

1. Consideration would normally be given to alternative fuels rather than oil for this space if it were to remain in use. A waste oil furnace if approved or other solid fuel-burning device could be used.
2. An air source heat pump could offset approximately half the oil used with a payback of approximately 8 years. The estimated capital cost is \$50,000 and savings in oil approximately \$6,000 per year.
3. An air curtain or means of preserving heat in the building during opening and closing of the truck doors. Assuming savings of approximately 5% can be achieved this represents savings of \$5,000 per year. The estimated cost of the system is \$15,000 therefore the calculated payback is 3 years.
4. A radiant floor heating system would store heat and provide more employee comfort without heating the air space or relying on convection to transfer heat.

5. Vehicle Fleet Assets - Basic Energy Audit

The Municipality of the County of Antigonish has two main classes of vehicles; light vehicles used for transportation of employees, light freight and equipment, and heavy vehicles used for municipal maintenance and services, such as garbage collection, handling at the landfill site, and road maintenance. The light vehicles are typically fueled by gasoline. Most of the heavy vehicles are fueled by diesel fuel.

The yardstick inventory audit indicates a total diesel fuel consumption of 140,769 liters. The largest use of this was for the garbage trucks, recycling trucks, dozer and excavator used at the landfill site. A second component added to transportation is the cost of transporting transferred garbage to the land fill in Guysborough and the cost of transporting recycled material to the bale fill facility in Colchester County. It is understood that approximately 17 tonnes of recyclables is transported to the bale fill site 1 to two times per week. The transferred garbage is transported in 30 tonnes loads once per week to the Guysborough landfill site. The total fuel used for recycling and garbage trucking is an additional 16,960 liters.

The light vehicle total consumption of fuel is 19,860 liters of gasoline. The largest use in light vehicles was to fuel small pickup trucks for public works and service vehicles while personal transportation for recreation and other employees accounted for the balance of the fuel use.

The total energy used by the fleet is 6,782,756 MJ or 6,783 GJ.

Fleet and Transportation Opportunities

Rationalization of vehicle use is even more important now with the recent and anticipated fuel cost increases. Opportunities to rationalize transportation and fleet assets may be achieved by utilizing each of the following approaches.

1. The first approach is to consider reduction in travel by; incorporating a travel plan, providing a logistical review of transportation requirements, tracking of transportation metrics, optimize service delivery with less travel, use remote communications, incorporate tele-working and telecommuting where possible, and use modern communications devices and remote sensing devices.
2. The second approach is to improve fuel efficiency of existing or newly planned vehicles.
3. A third approach is to improve performance of existing vehicles and drivers with training and equipment to optimize fuel-efficient practices.
4. Utilize alternative fuels other than gasoline or diesel for transportation.
5. Recover waste fuels and vehicle liquid and solid wastes.

Housekeeping Opportunities

1. Regular routine maintenance on vehicles has a direct impact on vehicle fuel and operational efficiency. Oil changes, filter replacement, tire inflation all have a measurable impact on fuel efficiency. Typically 3-5% savings on fuel can be expected from optimally maintained vehicles. This results in approximately \$4,800 annual savings.
2. Monitor and measure transportation statistics noting those that are trending outside of set targets. It is expected that the results of monitoring individual vehicle use may help provide savings of up to 5% or an annual fuel savings of \$8,000.

Minor Maintenance Or Operational Opportunities

1. Implement a “no idling” policy for both light and heavy vehicles. Assuming savings of 3% fuel results in \$4,800 annual cost savings.
2. For heavy vehicles provide separate electric or alternative fuel cab heaters. Ensure that during cold weather use that sufficient block heaters and receptacles are available to avoid warm-up and idling during breaks or lunch hours.
3. Implement programs such as NRC “Fleet –Smart” program for awareness of transportation issues as well as a source of driver/operator training programs where impacts of vehicle speed, braking and operations are considered.
4. Rationalize the correct vehicle for the job. Are more fuel efficient vehicles suitable for the task rather than a heavy, less fuel efficient vehicle?
5. Are the vehicles configured correctly with the lightest acceptable equipment for the job?

Retrofit Opportunities

1. Optimizing recycling loads.
The current trailer used to sort and transport recyclables consisting of cardboard and paper in one cell, and plastics, glass and metals in another cell, is fully loaded (volume limited) at approximately 17 tonnes of product. The container is a 53-foot tri-axle trailer capable of handling almost twice that loads, at 28 tonnes. The installation of a cardboard and a plastics compactor along with available storage of bales would allow the loads to be optimized reducing the travel by 50 %. The cost of two compactors is estimated at \$11,000 each for a total cost of \$22,000 installed. The annual fuel savings are estimated to be 5,000 liters of diesel at a cost of \$1.30 per liter or \$6,500 per year. The estimated payback is therefore 3.4 years.

2. Improve Scada System

Consider expanding a centralized and remote access SCADA monitoring system for municipal assets. Newer technology allows less expense and more effective remote monitoring capabilities to reduce the need to visit sites as often unless notified.

3. Remote monitoring with camera

Modern internet and wireless internet cameras can allow an operator to view and control a pan, tilt and zoom camera via the internet that will allow site inspection and general monitoring of remote indoor or outdoor assets. This type of technology can save travel time and costs. The cost of a single fully featured camera is approximately \$2,500. The anticipated savings of reducing travel to a particular site for monitoring or information gathering purposes by 50% is estimated at 25 trips x \$20 in fuel = \$500 annually. The simple payback on a single site is therefore calculated to be 5 years.

4. Alternative fuels

- a. Consider the use of alternative fuels such as an electric zambonie (ice resurfer). Battery powered Zambonie is available and fits well with electric vehicle applications. They are close to an electrical source and have periods of time to recharge. The air in the area will have less products of combustion and less heat is added to the ice shed. The cost of a new electric zambonie is approximately \$90,000 - \$100,000 versus the cost of the existing propane fired vehicle estimated to be approximately \$60,000. The fuel savings in propane amount to approximately \$6,000 per year for Antigonish. The payback on the incremental cost of \$30,000 at a \$5,000 annual savings is 6 years.
- b. If methane is recovered from the landfill or if natural gas is available to the County, the gas may be compressed into fuel ready bottles for use on gasoline or diesel vehicles. The cost to convert a current vehicle is about \$3,000. Natural gas fuel having less GHG emissions when consumed was quite competitive cost wise with gasoline even before the recent gasoline price increases. For vehicles that travel only within a limited area and can return for regular refueling compressed natural gas is worth considering.

6. Street and Area Lights

The municipality has a total of 257 street lights that currently consume a total of 211, 673 KWh per year. The estimated electrical consumption charge is calculated at \$0.10 per kWh and therefore the energy charge was \$21,127. The actual total cost billed for street

lighting was \$44,134. The additional \$22,996 difference is the cost of renting and maintaining the lights from Nova Scotia Power Inc.

Most of the streetlights are on an “unmetered” power rate, which consists of the energy charge plus the leasing, operation and maintenance rate. The rate varies with the type of light, how it’s controlled and its relative size or wattage.

It is noted from the inventory report that there are a total of 221 low wattage high pressure sodium lights, 27 low wattage mercury vapour lights, and 7 fluorescent lights. High-pressure sodium lights are among the most efficient of the HID (high intensity discharge) lamps. They provide a yellow almost monochrome light that provides illumination, however it does not provide colour rendition like a white light.

Street & Area Light - Opportunities

Housekeeping Opportunities

1. Ensure that all streetlights are maintained and illuminated and that automatic photo detectors are working and lights are not on during daylight hours. These fixtures are typically billed at the unmetered rate therefore the maintenance and energy consumption is the responsibility of Nova Scotia Power or the Town of Antigonish Utility. However it does impact the quantity and quality of light received, and additional electrical consumption does contribute to GHG emissions.

Minor Maintenance Opportunities

1. The mercury vapour fixtures installed are not required for superior colour rendition and therefore could be replaced with the higher efficiency low pressure sodium. This would reduce costs by approximately \$3.00 per fixture per month or $27 \times 12 \times \$3 = \972 annually

Retrofit Opportunities

1. Street Light Study
A survey and study of street & area lights should be undertaken to determine if they are suitable for the application. Areas no longer requiring lights should have fixtures removed, areas with excess lighting should be changed out to the appropriate size. The cost of a study may be approximately \$6,000 with expected annual savings of 10% of street and area lighting costs, resulting from the study and corresponding improvement in other area lighting. The savings are therefore approximately \$4,000 per year with a pay back of 1.5 years
2. Reduce Street Light Costs.
Typical area lights such as the exterior yard lighting at the St. Andrews STP and the landfill may be fed directly from existing building power supply panels.

Current design fluorescent or pulse start HID outdoor lighting fixtures are available with 25,000-hour lamps, reducing maintenance costs. The cost of a new fixture is assumed to be approximately \$400; the savings per month on the ownership is approximately \$20 per month or \$ 240 per year for payback of 1.6 years for each light. This is possible wherever yard lighting within 60 meters of an existing building is available. It is expected particularly on the larger 250-400 Watt fixtures that there are as many as 10 fixtures suitable for branch circuit feeds rather than non-metered power. The total savings in costs and improved efficiencies is estimated to be \$2,400 per year.

7. Water and Wastewater Assets

The municipality provides several water and wastewater plants for various communities in the County. Several of these facilities were visited in the course of the walkthrough audit. Those facilities with the greatest energy use and energy loads that operate over the longest periods of time were examined more closely. Plants that were typical of the ones examined were not visited. The same or similar opportunities may be used at each of these plants.

Description of Plants Visited During Walkthrough Audit:

Lower South River Waste Water Plant

This plant is a RBC (Rotating Biological Contactor) plant. It has an inlet equalization tank, digester tank, activated sludge return tank, as well as the RBC tank and contactor. There are two sets of blowers, each of 10 HP capacity. The blowers operate on a timed scheduled basis to ensure a minimum amount of DO (dissolved oxygen) in the water. The RBC has a continuously rotating contactor driven by a 5 hp motor. The chlorination building is heated by electrical power. The site is fed from a 200-amp, 3 phase 600 volt system.

Saint Andrew's STP site

This site is an aerated lagoon site with a single blower. The blower is a 10 hp belt driven blower and runs continuously.

Pomquet Waste Water Treatment Collection System and Plant

The Pomquet waste water treatment plant is a SBR (sequence batch reactor) system with two SBR tanks and an inlet equalization tank. The collection system provides grit removal. There are two 7.5 HP Hibon blowers that provide dissolved oxygen for the tanks. The SBR process is controlled by an automated sequence control system. There are two submersible SBR feed pumps and a Trojan UV disinfection system. The building is located directly on top of the concrete tanks, which are buried in ground up to grade level. Sewage is collected by a gravity and force main system. The building heat is electric but supplemented by waste heat from the process motors and process fluids.

St. Andrews Water Booster Station

This water booster station is typical of four other similar water booster stations. These are relatively new stations each enclosed in a small 12 square meter building with a single man door. Each station consists of two pumps, a main and lag pump, with a pump controller. The pumps are 10HP fixed speed, vertical motors, with a bypass pressure regulated control (bypass) valve to maintain the discharge pressure set point. Field instrumentation includes an electronic pressure transmitter and a magnetic flow meter.

The pump and instrumentation as well as building temperature and security status are connected to a SCADA system whereby information is remotely sent to a remote master interface. The booster station is electrically heated with back up propane heat in case of power failure. The electric service is a 100 amp, 3 phase 600-volt electrical service with a 15 KVA step down transformer to feed 240/120 volt loads, such as electric heat and lighting, forced air ventilation, and instrument controls.

Lower South River Water treatment Plant

The Lower South River water treatment plant is located at the top of the Antigonish County's Industrial Park. The water supply station consists of 4 submersible pumps feeding two parallel trains of water filters and water treatment vessels connected in series. A chlorination system is used to admit chlorine solution to the treated water for disinfection. The treated water is monitored for turbidity, pH and Cl₂ residual. The treated water discharge is then piped, via supply pump pressure, to a large water storage reservoir. The monitored systems parameters are measured and sent via a SCADA system to a master interface.

The building is approximately 40 square meters, single story with a slab floor, insulated walls and ceiling. Ventilation air is provided via a temperature controlled forced air system. The building and corresponding pumps are provided with 3 phase 208 volt power, the pumps are submersible and controlled by a pressure control system.

Water and Waste Water –Opportunities

Housekeeping Opportunities

1. Replace blower drive belts with v notched belts that can provide up to 1% better efficiency.
 - a. Lower South river STP blower drives. Operating cost savings assuming blower runs 50% of the time is $4000 \text{ hours} \times 9\text{Kw} \times \$0.10 \times 1\% \times 2 \text{ belts} = \$ 72 \text{ per year}$. The cost of two belts is assumed to be \$20 therefore a simple payback of 6 months.
 - b. St. Andrews Blower Drive. Assuming blower ruins constantly $8000 \text{ hr} \times 9\text{KW} \times \$0.10 \times 1\% \times 2 \text{ belts} = \$ 144 \text{ per year}$. The cost of two high efficiency belts is assumed to be \$20 therefore a simple payback of 3 months.

- c. Pomquet STP two SBR blowers: Operating cost savings assuming blower runs 50% of the time is 4000 hours x 9Kw x \$0.10 x 1% x 2 belts = \$ 72 per year. The cost of two belts is assumed to be \$20 therefore a simple payback of 6 months.

Minor Maintenance Opportunities

1. Lighting Upgrades

For plants with several lighting fixtures including out door lighting fixtures the Conserve Nova Scotia program may have some more efficient lighting fixtures to install.

2. NSPI has a program available for consumers of greater than 250KVA (total of several sites) to reduce electrical power consumption.

Retrofit Opportunities

1. RBC Plant -Reduce Blower electrical Consumption. (Manual System)

The aeration blowers run at a constant speed and provide air for the equalization tank and digester. The air requirements for these process tank change according to seasonal temperature fluctuations as well as elevation fluctuation for equalization tank. The blowers must maintain a minimum amount of DO (dissolved oxygen), this value can be monitored more frequently (weekly basis) and the speed or the run time of the blowers can be adjusted manually. A portable DO monitor is estimated to cost \$2,000. Assuming the excess DO measurement for seasonal adjustments is approximately 20% of the blower capacity, the anticipated savings can be calculated as 20% x 4,000 hours x 2 blowers x 10Kw each x \$0.10 kWhr = \$1,600 per year. The simple payback may then be calculated as 1.25 years. The excess DO particularly in cooler months will need to be checked to verify this assumption.

2. RBC Plant - Blower Consumption Reduction (Automatic System).

A fully automatic DO control system would include installing a permanent DO meter, connected it to a controller to compare measured DO with the desired setpoint. A variable speed drive can then be used by the blower motor to change the speed from a minimum to a maximum for the blower. Therefore low DO requirements, particularly during cooler ambient conditions, and low flow rates could automatically be achieved. The estimated savings are similar to the previous example but also include the discharge head variation of the equalization tank as well as constant modulation, therefore the anticipated savings in DO are expected to be approximately 30%. The saving is therefore calculated at \$2,400 per year for two blowers. The cost of two automatic systems including the sensors, controller and variable speed drives is approximately \$16,000. The calculated simple payback is therefore 6.8 years. Instead of a variable speed

where DO control can be staged the controller can utilize timers saving approximately \$4,000 and reducing the payback to 5 years.

3. St. Andrews STP Blower Motor Power Consumption reduction.

A portable DO meter could determine if the blower motor at St. Andrews STP could be cycled on and off. If so a similar controller (item 2) and permanent DO meter could be installed at this site. The estimated cost of the DO meter and controller is \$5,000 and the cost savings of approximately \$1200 per year for a calculated payback of 3.5 years (assuming 25% reduction in DO load over a period of 1 year).

4. Improve Plant Motor Efficiency.

By replacing standard efficiency motors with high efficiency motors normally 3-4% reduction in electrical consumption costs can be achieved. This makes particular sense for any motor that operates more than 4,000 hours per year. A motor rewind can also reduce standard motor efficiency by another 3-4%. Therefore all re-wound motors should be considered for replacement to high efficiency motors, particularly if they run for more than 2000 hours per year. Any new or replacement motors should be high efficiency motors only

- a) Two suitable motors for the Lower South River RBC plant include the RBC rotator (5hp) and the commutator motor (1 hp). Both run constantly and 8,760 hours per year. The electrical load if these motors were replaced with high efficiency would be reduced and save approximately $6 \text{ kW} \times 3\% \times 8760 \text{ hours} \times \$0.10 = \$157.68$ per year. The cost of the upgrade is estimated to be \$1,200 the calculated payback is therefore 7.68 years.
- b) The blower for St Andrews also runs constantly as the motor is standard efficiency, therefore savings are $10 \text{ KW} \times 8760 \times 3\% \times \$0.10 \text{ kWhr} = \$262.8$ annually. The cost for installing a new high efficiency motor is approximately \$1,000 therefore the simple payback is calculated to be 3.8 years.
- c) Pomquet SBR STP blower motors may also be considered if blower motors run more than 4000 hours per year, or when a motor is being replaced.

5. Reduce Water Booster Pump Electrical Consumption.

Rather than running a water booster pump continuously at full speed and bypassing flow (throttle valve) for pressure control a variable speed pump can more effectively provide pressure control and reduce pump speed during a period of low flow rate. Pressure reduces at the square of the pump speed therefore even a 50% reduction in bypass flow will only consume 25% of the power, saving 75% of the energy. Assuming even 50% reduction the potential savings are calculated as $10 \text{ kw} \times 8,760 \text{ hr/year} \times 50\% \times \$0.10 = \$4,380$. A variable speed drive and

pressure controller would cost approximately \$4,000 therefore the simple payback is approximately 1 year. There are four similar pumping stations

6. Reduce Transformer Losses.

The electric heat and lighting at each of the booster pumping stations is typically through a 15KVA transformer (standard efficiency 150 degree temperature rise), which feeds a 240/120 volt panel. A transformer has a no load loss of approximately 2-3% throughout the year including summer when heat is not required. It is possible to replace these transformers with a more efficient type, however both electric heating and lighting are available at 347 volts and can be fed from a 600 volt 4 wire system without a transformer. The potential cost savings are $15\text{KVA} \times 2.5\% \times 8760 \text{ hours} \times \$0.10 = \$328$ per year. The cost of replacing the heater and light fixture are estimated at \$400. Therefore this is approximately a 1-year pay back for each of the four booster stations.

7. Reduce Electrical Demand Charges by Power Factor Correction.

All motor and most lighting loads require magnetic (reactive) power. This component of power is added into the KVA demand portion of a power bill. Power factor correction capacitors can be added to poor power factor loads to reduce the amount of reactive power and the size of the peak demand measurement, saving costs on the energy bill and saving some electrical consumption. Typical power factor for STP and WTP is likely 80%, however this can be improved to 95%. The reduction in demand portion of the power bill can be reduced typically by 15%. The current demand charge is approximately \$9 per KVA demand per month. The cost of capacitors is about \$100 per HP installed. The savings are related to peak usage in each month rather than total or consumed usage.

- a. The lower south river STP plant could have 4-5 capacitors installed, the net effect is a savings of $15\% \times 25 \text{ KVA} \times 12\text{months/year} \times \$9.00/\text{KVA month} = \405 per year. The cost of capacitors for this plant is \$5,000. Therefore the payback is 12.3 years.
- b. For St. Andrews the costs are less since there is only one larger motor the cost to install is approximately \$700 and the savings are calculated at $15\% \times 12 \text{ KVA} \times 12\text{months/year} \times \$9.00/\text{KVA month} = \195 per year. Therefore the simple payback is 3.5 years
- c. For Pomquet STP the cost to install is similar to lower south river and similar savings.
- d. The WTP at Lower south river is estimated to cost \$4, 000 and the estimated savings are estimated to be $15\% \times 20 \text{ KVA} \times 2\text{months} \times \$9. \times \$0.10 = \324 per year therefore payback is 10-12 years

8. Reduce Heat Loss in Water Treatment Building.

The water treatment plant at south river contains several filters vessels and tanks with cold surfaces from the inlet temperature of the well water. These surfaces absorb the heat in the room in winter and provide surfaces for humid air to

condense in the summer. A removable insulated jacket will assist with both scenarios. In order to calculate the heat absorption by the tanks they are assumed to be similar to constantly cold surface with a temperature difference of 15 deg. C. Water slightly warmed is constantly flowing out of the building and new cool water is coming in. A heat transmittance value of $12 \text{ W/m}^2 \times \text{deg. C}$ (similar to 25mm of glass) is assumed, and the estimated surface area of tanks and pipes is 45 m^2 , therefore the heat loss is calculated as $Q = 16,875 \text{ W/hr}$ or about 50 % of the electric unit heaters capacity. This is equivalent to $8.4 \text{ kW} \times \$.10 \text{ kWhr} \times 3,000 \text{ hours (heating season)} = \$2,540$ per year. The cost of installing an insulating jacket and piping material is estimated at \$4,000; therefore the payback is less than two heating seasons. The insulation will also reduce the amount of condensation dripping to the floor. The lower south river water treatment plant has an electrical energy charge of approximately \$8,000 per year.

8. Recommendations

In general for each of the category types, opportunities with a payback of less than 3 years have been identified as priority opportunities for implementation. A calculated payback of less than 3 years is considered a good financial investment.

The main objective of the Eco-Trust program is to identify opportunities to reduce green house gases and save energy for the municipality. The Eco-Trust program also provides funding incentives for selected opportunities that make those opportunities more attractive to implement. The recommended opportunities for implementation under the Eco-Trust program are therefore those projects with the greatest opportunity to reduce green house gases and at the same time provide a reasonable investment payback to the municipality. The opportunities listed in this report under the longer-term "Retrofit" category with a payback of between 3-7 years are considered optimum value projects for Eco –Trust implementation. Those opportunities identified as an Eco-Trust program implementation are highlighted in yellow in the list of opportunities spreadsheet.

The three main opportunities identified for further analysis under the Eco-Trust program are as follows:

1. Antigonish Arena ice plant heat recovery and storage system. This project represents significant energy savings and is sensitive to the increasing price of both fuel oil and electrical costs.
2. A ground source or air source heat pump may be considered to provide more efficient space heating and alternative fuel to reduce oil consumption and improve comfort at the Municipal administration building via use of a heat pump to supplement or replace existing oil furnace.

3. Heat loss reduction at the Antigonish County Court House and building envelope improvements. This project will provide reduced heat losses and savings in fuel consumption for the Historic Antigonish Court House building.

Opportunities with short paybacks identified for certain municipal assets that may have a future changes have been adjusted in the priority list. For example the public Works maintenance operation will be moving to a new maintenance facility in the near future, as well the Antigonish Detention Center may also be relocated in the future. Opportunities that result in larger benefits have also been adjusted to have a greater priority. An opportunity to save \$5,000 per year over \$50 per year has been given a higher priority. Several opportunities may be combined together and some depend on certain activities occurring before or at the same time in order to realize the best benefit. Therefore opportunities with these restrictions have been provided with an adjusted priority. Those opportunities listed in the attached spreadsheet in the appendix highlighted in blue are recommended for implementation by the County of Antigonish.

Each of the opportunities described in the report are listed in the appendix in a spreadsheet. The spreadsheet is sorted as per the report, by category type, and by priority. The opportunities recommended for the Eco-Trust program have been highlighted in yellow and given priorities E1 to E10 and the opportunities recommended for implementation by the county have been highlighted in blue and given priority number ranges beginning with H1, M1, R1 for housekeeping, minor maintenance and retrofit opportunities respectively.

As described in the methods section of this report “House keeping” opportunities may be implemented via County staff with internal scheduling and planning. “Minor Maintenance” and “Retrofit” opportunities will require outside services and may require budgeting and normal council project approval and funding process.

9. Appendix

Opportunity List Spreadsheets

1. Eco-Trust Opportunities –listed By Asset and Report Section
2. Eco-Trust Opportunities –listed By Opportunity Category and Payback
3. Eco-Trust Opportunities –listed By Opportunity Category and Priority

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