Village of Pemberton

Corporate Energy and Emissions Study

March 2013

2512.0005.01

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Village of PEMBERTON

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

Table of Contents

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

1.0 Introduction

1.1 Background

The Village of Pemberton is considering ways to reduce its greenhouse gas emissions from its corporate operations and to reduce costs associated with energy consumption. In doing so, the Village will begin to meet some of the commitments it made when it signed the BC Climate Action Charter as well as community greenhouse gas emission reduction targets made through the 2010 Official Community Plan.

In 2011, the Village spent approximately $150,000 on energy consumption, which generated approximately 150 tonnes of greenhouse gas emissions (commonly equated to CO_2E). In order to achieve its commitments under the Climate Action Charter to reduce greenhouse gas (GHG) emissions and to reduce the costs associated with energy consumption, the Village has commissioned this report to analyze its energy consumption patterns and to make recommendations on potential improvements.

1.2 Scope of Report

This report has three components including:

- ***Understanding energy and provincial considerations at a broad level –*** Sections 2 and 3 of this report describe the various sources of energy that the Village uses and how these generate GHG emissions, while also discussing the relevant pieces of provincial legislation and guidance that provide impetus for undertaking improvements to energy consumption patterns;
- ***Energy use –*** Section 4 of the report provides a summary and analysis of the Village's energy consumption patterns at a broad level for 2010, which is the year that had the most complete dataset with which to work with. The inventory includes buildings, lighting, municipal facilities, water and sewer infrastructure, and fleet vehicles; and
- ***Options –*** Section 5 outlines steps the Village can undertake to begin to make substantive changes to the amount of energy that is consumed in its corporate operations while Section 6 provides some direction for moving forward.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

2.0 Understanding Energy and GHG Emissions

> *"According to Tree Canada, it takes, on average, 98 trees to absorb 1 tonne of carbon dioxide per year. The Village's emissions would require approximately 14,700 trees to be planted each year to absorb the greenhouse gas emissions associated with the Village's operations."*

The Village utilizes electricity, propane, gasoline and diesel to provide energy to its operations. These sources of energy have different costs and GHG emissions associated with them. Before analyzing energy use, it is important to review the types of energy and their associated costs and impacts on GHG emissions in the BC context. **Table 2.1** provides a brief summary of each of the sources of energy, how much they cost, their relationship to greenhouse gas emissions, and how they are used in Pemberton.

Table 2.1: Summary of Energy Sources for Pemberton

Source of Energy	Cost (2012)	Source	Relationship to Greenhouse Gas Emissions	Uses in Pemberton
Electricity	$0.0915 per kwh (small general service rate)	BC Hydro – mostly through hydro-electric dams	25 grams CO_2E /kwh – amount of electricity for 2 -3 houses in one year would be approximately 1 tonne	Building heating, power for pumps, ventilation, air conditioning, lighting
Propane*	Approx. $0.80 per litre	Superior Propane – fossil fuel derived from the refinement of oil	1.54 kg CO_2E/litre	Building heating at Public Works building
Diesel*	Approx. $1.25 per litre	Fossil fuel from the refinement of oil	2.76 kg CO_2E/litre – filling up a small car 9 times would be equivalent to 1 tonne	Vehicles and heavy duty equipment, pumps
Gasoline*	Approx. $1.25 per litre	Fossil fuel from the refinement of oil	2.41 kg CO_2E /litre filling up a small car 10 times would be equivalent to 1 tonne	Vehicles

*Prices are based on their market prices (source: Natural Resources Canada)

Pemberton differs from a number of municipalities in that a large proportion of building heating is done using electricity, whereas, many communities with

Village of PEMBERTON

URBAN systems

REPORT

Corporate Energy and Emissions Study

2512.0005.01

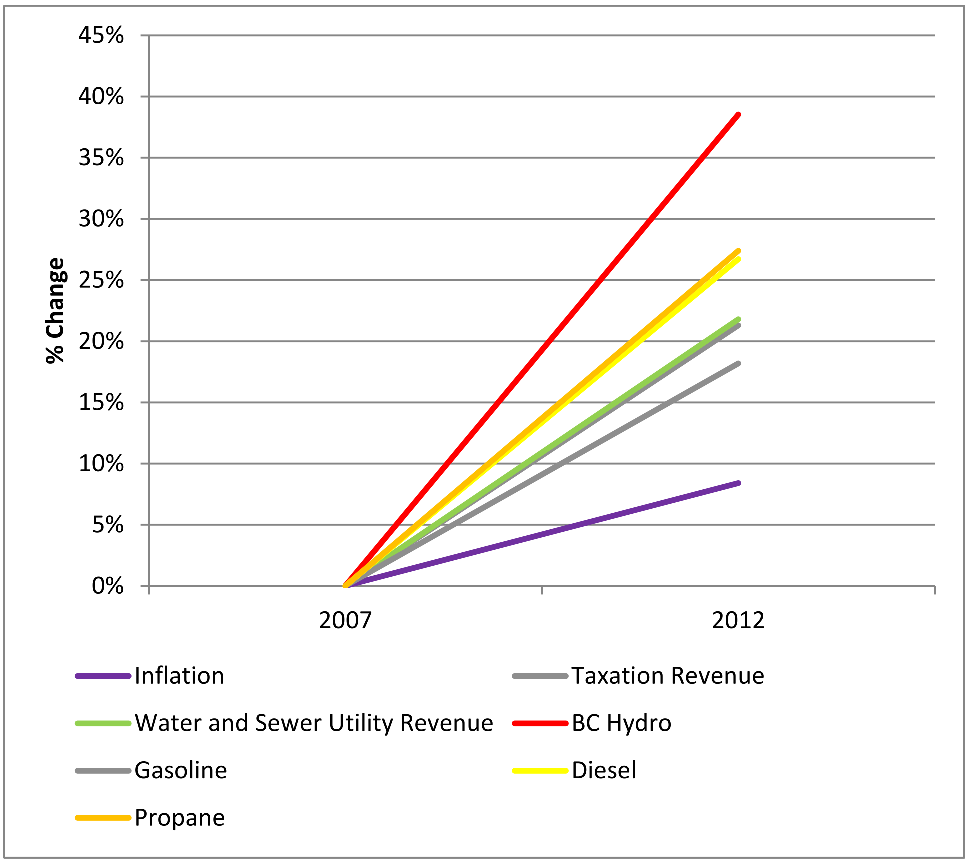
March 2013

access to natural gas use that for building and water heating. More information on sources of energy is provided in **Appendix A.**

2.1 Energy Costs in Relation to Revenue

The prices of the various sources of energy that Pemberton uses on a regular basis have increased significantly over the last few years. Since 2007, energy prices have increased at a rate much greater than the rate of inflation. In addition, energy prices have increased at higher rates than both taxation revenue and water and sewer utility revenue. With the exception of gasoline, the overall change in taxation and water and sewer utility revenue has been less than the increase in energy costs. Electricity has experienced the greatest increase in costs over the last 5 years, averaging an increase of 6.7% per year during that time period. **Figure 2.1** summarizes changes in various costs and revenues.

Figure 2.1 – Change in Energy Costs and Municipal Revenue – 2007 - 2012



Sources: Natural Resources Canada (propane, diesel and gasoline prices), BC Hydro, Village of Pemberton Annual Report

A key result of energy costs increasing at rates greater than revenue is that paying for energy is taking a larger proportion of municipal budgets.

Village of PEMBERTON

URBAN systems

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

3.0 Provincial Considerations

Along with understanding the various sources of energy, it is also important to understand the emerging provincial considerations as they relate to energy and GHG emissions. The Province, in the last five years, has identified significant goals to improve energy use and reduce carbon emissions. These goals have emanated largely from the *BC Energy Plan,* the *BC Climate Action Plan,* and the *Climate Action Team Report.* Specifically, these goals and initiatives include:

- Establishing the Climate Action Charter – at the UBCM conference in 2007, local governments from across the province signed the Climate Action Charter which committed signatories to working towards carbon neutrality in their operations by 2012.
- Introducing carbon taxation – BC is one of the first jurisdictions in North America to implement carbon pricing. Starting in July 2008, all fossil fuels were taxed based on the amount of carbon they produce through consumption, starting at a base rate of $10 per tonne and escalating to $30 per tonne by 2012. This could increase even further in the future, though there are no plans at present for an increase. At the 2008 Union of BC Municipalities (UBCM) convention, the province announced that municipalities who have signed the Climate Action Charter, such as the Village of Pemberton, would receive a rebate on carbon taxes paid through the Carbon Action Revenue Incentive Program (CARIP).
- Legislating through Bill 27 that municipalities include targets, policies, and actions in their Official Community Plans that pertain to greenhouse gas emissions by May 31, 2010.
- Reducing the energy demand at work by 9% per square metre by 2020 for commercial and institutional buildings.
- Reducing provincial greenhouse gas emissions by 33% by 2020. This target has been matched by the Village of Pemberton in its Official Community Plan.
- Acquiring 50% of BC Hydro's incremental resource needs through conservation by 2020.
- Mandating Provincial electricity self-sufficiency based on average water levels, by 2016 and corresponding commitment that electricity will come from carbon neutral sources through the BC Energy Plan.
- Mandating provincial government carbon neutrality for government operations by 2010 – the Greenhouse Gas Reduction Targets Act

Village of PEMBERTON

URBAN systems

requires that the provincial government be carbon neutral in its operations by 2010.

- Requiring that BC Hydro install smart meters for all customers by 2012. Smart meters will take accurate electricity usage readings at regular intervals and provide feedback to the customer.
- Enacting legislation giving municipalities the opportunity to incorporate energy and water efficiency considerations into development permit area guidelines.
- Allowing flexibility in Development Cost Charges (DCC) to encourage energy efficiency and low impact development.
- Developing the new Provincial Green Building Code which requires new homes to achieve an EnerGuide rating of 77 which infers higher energy efficiency. The Green Building Code makes low water use fixtures mandatory.

3.1 Carbon Neutrality

There has been much discussion surrounding the topic of carbon neutrality, particularly as the province has committed itself to being carbon neutral in its operations by 2010 and a number of municipalities, such as the Village of Pemberton, have voluntarily committed to working towards carbon neutrality by 2012. Carbon neutrality means reducing greenhouse gas emissions to achieve a net of zero emissions. There are generally three steps to becoming carbon neutral: 1) calculating carbon emissions from corporate operations and ancillary activities; 2) reducing carbon emissions through conservation measures such as changing transportation habits and evolving to cleaner energy supplies (i.e. convert to solar hot water heating); and 3) buying carbon offsets that contribute to projects that displace GHG emissions.

Carbon Neutral ABCs	
A	Measure your local government emissions
B	Reduce these emissions as much as possible
C	Invest in projects that reduce emissions equivalent to your remaining emissions by purchasing offset

Source: Climate Action Toolkit Website

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

3.1.1 Carbon Inventory

The Village, as a signatory to the Climate Action Charter, will need to inventory all its carbon emissions and purchase offsets for these emissions to bring them to a net of zero. The Green Communities Committee, a joint partnership between the province and UBCM, has undertaken some work to detail the boundaries of what would need to be included in the carbon inventory. In September 2009, a report was released by UBCM that provided some boundaries for the carbon inventory. Signatories to the Climate Action Charter have to report on the greenhouse gas emissions that result from energy used to provide traditional municipal services (i.e. parks, recreation, fire protection, community facilities, infrastructure, lighting, etc.). In addition, GHG emissions from any typical municipal services that the municipality contracts out, such as solid waste collection and snow plowing, will need to be included, though this is to be phased in as part of future contracts.

3.1.2 Carbon Reduction

There are many initiatives a municipality such as Pemberton can undertake to reduce carbon emissions. These are outlined in more detail for Pemberton later in this report, but at a broad level, replacing fossil fuels with renewable energy resources and reducing the use of fossil fuels are the most effective means of reducing carbon emissions. These actions will result in an absolute carbon reduction, and in many cases, over the long-term, which is required. For instance, if the Village were to remove propane heating at the Public Works building and replace it with electric-based heat, they could reduce their GHG emissions significantly for that building resulting in a long-lasting absolute reduction in GHG emissions. Conservation techniques also have significant benefits to carbon reduction. It is important to note that, due to BC's reliance largely on low carbon intensity electricity sources, reducing electricity usage does not result in significant GHG reductions.

3.1.3 Carbon Offsetting

Carbon offsetting is compensating for GHG emissions by funding external programs/projects aimed at reducing GHG emissions or increasing carbon dioxide absorption outside of the municipal core operation. Important concepts to offsetting are additionally, and verifiability. Carbon offsets that are purchased must result in an investment that would typically be outside the current capacity of the organization they are being invested in. For example, without significant investment, there would be little potential for some remote communities to switch from diesel power generation to a cleaner energy source such as solar photovoltaic. Thus, if an offsetting initiative invested in this upgrade, it would be considered in addition to the typical scenario. Verifiability requires that there be documented evidence that the offset will, and is, resulting in reductions of GHG emissions. Third party independent audits are often mandated to verify that the offsets are working.

Carbon offsets are typically purchased through a carbon offsetting organization which charges a certain amount of money per unit of carbon produced and subsequently reinvests this money into initiatives outside of the municipal organization that reduce carbon. These reinvestments often are made in one of three ways - tree planting/no-till agriculture; clean energy production; or energy conservation. These could be considered, in general, as either natural-based offsets or technological-based offsets.

The provincial Pacific Carbon Trust is an initiative of the BC government to provide a fund that can collect carbon offsets from provincial government operations and reinvest them into projects that will reduce CO_2E emissions. The program will be available to municipalities participating in the Climate Action Charter agreement to be carbon neutral by 2012. Funds that are collected will be reinvested in projects throughout BC. One disadvantage of purchasing offsets from external organizations is that there is no guarantee that the funds collected will be reinvested in initiatives local to Pemberton.

An alternative to purchasing carbon offsets is for the municipality to pay directly for projects that reduce greenhouse gas emissions outside of their municipal operations. The UBCM Green Communities Committee (GCC) has outlined four such projects that could be invested in to reduce emissions. These include:

- Energy efficient building retrofits/fuel switching;
- Solar hot water;
- Household organic waste composting; and
- Low emissions vehicles.

The advantage of these types of projects is that the reporting protocol has been established and as such, the monitoring and auditing of emissions reductions is simpler.

Another option is for municipalities to invest in projects that are not part of the four mentioned above. These projects could include other alternative energy projects, district energy systems, etc. Since they are not part of the four project types that the GCC supports, there are more requirements that need to be adhered to in monitoring and auditing the emissions reductions. Investments in local projects will cost significantly more than investments in carbon offsets. However, by investing in local emission reduction projects, the Village supports local economic development, builds capacity, and ensures that money is not leaving the community.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

4.0 Village of Pemberton Energy Use and Emissions Baseline

4.1 Methodology

A building and fleet inventory for the 2010 baseline year was established through a general review of the Village's energy records. Each building and each fleet account was assigned to a relevant category based on type of municipal operation.

The categories include:

- Community Lighting
- Fleet
- Water/Sewer
- Administration and Governance Buildings

The Village has also recently added facilities that would fall under the Arts, Recreation and Culture category. However, these have not been analyzed in this report due to a lack of available data.

Records of the Village's energy use were collected from the relevant sources. These include:

- Electrical use – BC Hydro billings;
- Propane use – Village records; and
- Vehicle Fuel – Village records.

For each of these sources of energy, the amount of energy used as well as the energy costs was established. GHG emissions were based on emission factors developed as part of the Province of BC's *Methodology for Reporting BC Local Government Greenhouse Gas Emissions*. These factors include:

- Electricity – 25 grams CO_2E/kwh;
- Gasoline – 2.41 kg CO_2E/litre;
- Diesel – 2.76 kg CO_2E/litre; and
- Propane – 1.54 kg CO_2E/litre.

These factors were applied to energy consumption values to estimate the total GHG emissions. A list of buildings, infrastructure and fleet vehicles that were analyzed as part of this study are provided in **Appendix B** with a summary of energy consumption, costs, and greenhouse gas emissions.

REPORT

Corporate Energy and Emissions Study

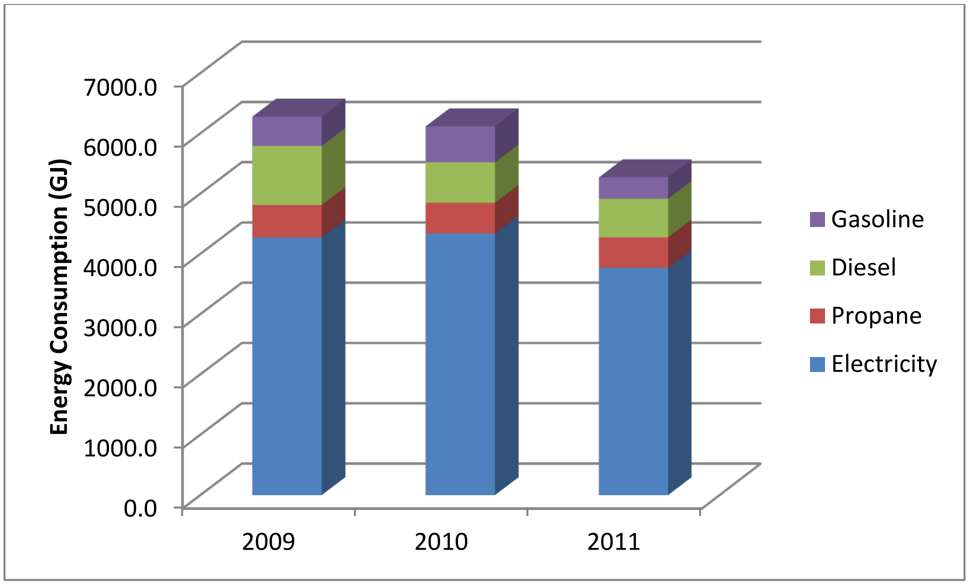
2512.0005.01

March 2013

4.2 Summary of Energy Consumption

As illustrated in **Figure 4.1,** overall energy consumption has declined over the last three years, particularly between 2010 and 2011. Much of the energy consumption decrease is attributable to decreases in the use of fleet fuel as well as electricity, particularly at the sewage treatment plant.

Figure 4.1 – Energy Consumption – 2009 - 2011



As indicated in **Table 4.1**, the bulk of energy consumption is for water and sewer utilities, comprising over 50% of energy consumption, with the sewage treatment plant and the Aster Street Pump Station consuming the greatest amount of energy.

Table 4.1: Energy Consumption by Municipal Sector – 2009 - 2011

	Administration and Governance Buildings	Water and Sewer Utilities	Community Lighting	Fleet
2009	20%	52%	5%	23%
2010	23%	51%	5%	21%
2011	22%	52%	7%	19%

Village of PEMBERTON

URBAN systems

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

4.3 Summary of Energy Costs

As noted in **Table 4.2**, the Village of Pemberton spent approximately $150,000 on energy consumption, representing approximately 5% of taxation and water and utility servicing revenue. Approximately 65% of the costs were for electricity. While energy costs have increased significantly on a per unit basis, the Village has managed to reduce energy costs by reducing fleet costs and reduction in energy consumption at the Sewage Treatment Plant.

Table 4.2: Energy Costs by Energy Source – 2009 - 2011

	Electricity	Propane	Diesel	Gasoline	Total
2009	$97,065	$16,859	$25,505	$13,076	$152,505
2010	$108,167	$16,256	$18,586	$17,233	$160,243
2011	$100,467	$18,625	$21,083	$11,810	$151,984

Spending on water and sewer utilities represented the largest expenditure for energy by sector. The money spent on energy for the water and sewer utility represented 5% of water and sewer utility revenue. **Table 4.3** summarizes energy costs by each municipal sector.

Table 4.3: Energy Costs by Municipal Sector – 2009 - 2011

	Administration and Governance Buildings	Water and Sewer Utilities	Community Lighting	Fleet	Total
2009	$35,033	$66,987	$11,903	$38,581	$152,505
2010	$39,468	$71,020	$13,936	$35,819	$160,243
2011	$37,331	$66,935	$14,825	$32,893	$151,984

It is important to note that a few facilites account for the majority of overall energy costs. The facilities listed in **Table 4.4** account for approximately 53% of overall energy costs.

Table 4.4: Energy Consuming Facilities – 2009 - 2011

Facility	Costs
Aster Street Pump Station	$33,238
Sewage Treatment Plant	$25,830
Public Works Building	$18,625
Total	**$77,693**

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

4.4 Summary of Greenhouse Gas Emissions

In 2011, energy consumption resulted in greenhouse gas emissions of 128 tonnes CO_2E which represents a significant decrease from 2010 and 2009. Emissions from the use of diesel represent the greater amount those these have decreased significantly since 2009. **Table 4.5** summarizes emissions from various sources of energy.

Table 4.5: Emissions by Energy Source – 2009- 2011 (tonnes CO_2E)

	Electricity	Propane	Diesel	Gasoline	Total
2009	29.7	31.9	74.3	32.2	168.1
2010	30.1	30.2	50.8	39.5	150.7
2011	26.2	30.0	48.6	23.4	128.2

Emissions from the corporate fleet account for the majority of the Village's emissions at approximately 56% of overall emissions. **Table 4.6** summarize the Village's corporate GHG emissions by sector from 2009 – 2011.

Table 4.6: Greenhouse Gas Emissions by Municipal Sector – 2009 – 2011

	Administration and Governance Buildings	Water Utilities	Community Lighting	Fleet	Total
2009	36.8	22.5	2.3	106.5	168.1
2010	36.4	21.7	2.3	90.4	150.7
2011	34.6	19.1	2.4	72.1	128.2

4.5 Water and Sewer System Energy Consumption

As indicated in the previous sections, a large amount of energy is used to power the Village's water and sewer utility infrastructure. Water and sewer utilities account for approximately 44% of energy costs, much of this for the Aster Street Water Pump Station and the Sewage Treatment Plant. In recent years, there have been a number of changes at the Sewage Treatment Plant which have resulted in significant energy consumption reductions at that facility. These improvements include:

- Better monitoring the oxygen content of the basins, reducing aeration times, thus reducing blower use by 360 minutes per day;

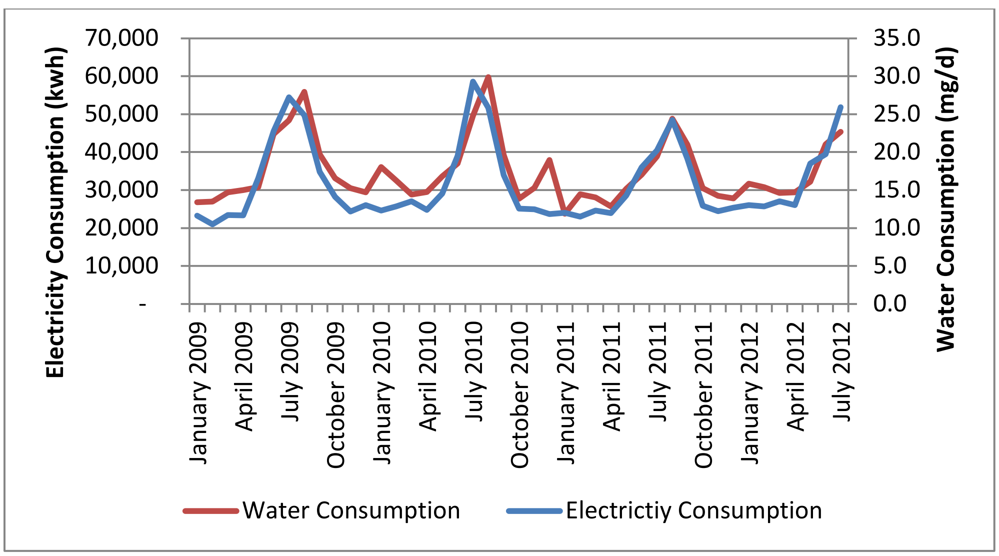
Village of PEMBERTON

- Decanting the digesters and monitoring the quality of the sludge, which reduce the press usage and wash water consumption;
- Having outdoor lighting turned off instead of being on a sensor; and
- Fine tuning the set points for the headworks screen which reduced the run time from 720 minutes per day to approximately 450 minutes per day.

Together, these improvements have reduced energy consumption by approximately 25% and reduced costs by $8400 per year based on current prices for electricity. Without significant investments into the plant, it is unlikely to that further reductions could be achieved.

A review of energy consumption in the pumping of water was also undertaken, particularly in terms of the relationship of the amount of water pumped and energy consumed. Based on the analysis, there is a very high correlation between water pumped and energy consumed. The correlation is even higher for water pumped in the summer. **Figure 4.2** illustrates the relationship between water consumption and energy consumption.

Figure 4.2: Relationship Between Water Consumption and Energy Consumption



Currently, the Village uses approximately 0.56 kwh of electricity to pump a cubic metre of water.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

4.6 Overall Summary

Table 4.7 provides a summary of the Village's energy consumption.

Table 4.7: Summary of Energy Consumption (2011)

	Administration and Governance Buildings	Water and Sewer Utilities	Community Lighting	Fleet	Total
Total Energy Expenditures	$37,331	$66,935	$14,825	$32,893	$151,984
Emissions (tGHG)	34.6	19.1	2.4	72.1	128.2
Carbon Offsets Required	$865	$478	$60	$1,802	$3,205
Total Energy Consumed (GJ)	1173.4	2754.4	345.7	995.4	5268.9

Some of the salient points from the review of energy consumption patterns include the following:

- Energy for the water utilities represents the highest costs – the Village spends the most money on energy for the water and sewer utilities. However, since this is all electricity, the resultant GHG emissions only represent about 15% of the Village's total;
- Emissions from the fleet represent about 56% of total emissions but only 22% of overall costs; and
- The Village's expenditure on energy will increase – given the combination of increasing energy prices and increase in municipal services due to community growth, the Village's spending on energy may increase by nearly $80,000 per year by 2020.

4.7 Energy and Emissions Forecast

In order to provide some context on future energy expenditures and greenhouse gas emissions, a forecast was undertaken to determine how much energy will be used and the resultant costs will be in the future up to the year 2021. In order to undertake this analysis, the following assumptions were made about the nature of Pemberton's assets and services:

- No expansion or replacement of buildings – while replacement of buildings is anticipated in the future, no timeline has been established;
- Modest increase in energy consumption for the water utility – it was assumed that energy consumption on the water and sewer utility would increase by 3% per year to account for an increase in properties

connecting to the systems and potential addition of pumps and lift stations;

- No increase in fleet fuels – it was assumed that there would be no increase in fleet fuels use. Unless the Village expands dramatically, it is unlikely that there will be a need to expand the fleet and equipment. At the same time, it is assumed that as vehicles and pieces of heavy duty equipment are replaced, they will become more fuel efficient than previous models;
- Small increase in Administration and Governance Buildings and Arts, Recreation and Cultural Facilities – it was assumed that energy use would increase at these facilities would increase at approximately 2% per year to account for the addition of energy consuming assets as well as the gradual decline in energy efficiency of buildings.

Further, the following assumptions were made about changes in energy costs over the next 10 years:

- Electricity – increase in price of 3% per year
- Diesel and Gasoline – increase in price of 2% per year
- Propane – increase in price of 2% per year

Based on this review, it is estimated that the Village will spend approximately $230,000 on energy, resulting in approximately 136 tonnes CO_2E of greenhouse gas emissions by 2021. This represents 51% increase in energy costs from 2011 to 2021.

4.8 Key Issues

There are several areas where the Village could likely reduce energy consumption. These include:

Buildings – the Public Works building is an expensive building to operate. In fact, all the municipal buildings are older, and, anecdotally, inefficient to operate. While replacement of these buildings is intended in the future, in the interim, there are opportunities to reduce the energy consumed in these buildings.

Water pumped – the Village, to make substantial energy savings needs to address the amount of water pumped and how it is pumped. Due to the relationship between water pumped and electricity consumed, the Village needs to review water conservation programs, particularly in light of the relatively high per capita daily water use.

Fleet – if the Village wants to reduce greenhouse gas emissions, it will need to focus on reducing the amount of fuel used for the fleet.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

5.0 Directions for Moving Forward

The amount of money that the Village spends on energy is manageable and the resultant greenhouse gas emissions are minimal, when compared to the situation faced by other communities. Unless the Village wishes to spend significant amounts of money to reduce energy use with low potential for a return on investment in a reasonable amount of time, it is likely that the preferred course of action is to implement options that require minimal to no upfront costs but deliver tangible reductions in energy consumption. This section summarizes the potential initiatives the Village could undertake moving forward.

5.1 Organizational Initiatives

There are a number of broad initiatives that the Village should consider to promote more sustainable energy use. These include the following:

Develop Council awareness of corporate energy issues – as the Village moves forward with implementing the recommendations of the corporate energy study, it will be important to have the ongoing support and involvement of Council. It will be important to have continual education of Council through workshops and other sessions which provide information on energy and climate change issues. This will help Council to develop more informed policies and bylaws in order to achieve specific goals relating to energy and greenhouse gas emissions. An annual energy report should be prepared that highlights the Village's energy consumption, costs and greenhouse gas emissions.

Develop Council policies supporting energy and GHG actions – a series of Council policies should be developed that mandates energy efficiency in municipal operations and provides guidance to staff on how energy and GHG emissions should be considered in the municipal realm. Specific policies include:

Greenhouse gas emissions and energy consumption reduction target – the Village should commit to reducing greenhouse gas emissions from its operations by 10% by 2020. A target should also be adopted that requires the municipality to reduce energy consumption by 15%. Refer to **Appendix C** for more details on how these targets could be achieved.

Carbon neutrality – this would identify how the Village would achieve carbon neutrality, particularly in terms of how it would offset greenhouse gas emissions and where these would be purchased. As a first step, the Village should consider allocating $3000 per year for the purchase of carbon offsets.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

Procurement policy – a procurement policy should be established that would:

- Require construction and service contractors to track greenhouse gas emissions that occur as part of their work for the Village. The Village should develop a policy on how contractors are to report this information and develop standard policies to incorporate into tenders;
- Require that the municipality procure supplies from suppliers of higher value goods and services that take into account greenhouse gas emissions in their operations;
- Require that future buildings be constructed to meet LEED Gold or equivalent standards; and
- Require that future vehicles and equipment purchased balance cost, fuel consumption and intended use.

This will enshrine the goals and targets mentioned above and provide the support for staff initiatives and investments in programs, capital works, and equipment and contractor purchases that result in more sustainable use of energy and fewer GHG emissions.

Provide employee education opportunities – critical to the success of an energy management program is to have high levels of employee engagement from the outset. Employee engagement requires a combination of empowerment, education, and training to ensure employees fully understand energy issues, and how they can make a difference within the organization. The City of Richmond, for instance, has trained much of its staff on energy management issues. Engaging employees in energy management can be as simple as providing educational materials in well thought out locations (i.e. stickers above light switches reminding people to turn off lights) to facilitating more active participation in energy conservation programs (i.e. decisions around heating and cooling loads). The desire for further energy-related education was reflected in the employee survey. Educating employees about the impact their behaviour has on energy use is critical. Programs like BC Hydro PowerSmart program for electricity use, Natural Resources Canada's AutoSmart online video series program for driving, and Green Buildings BC are examples of programs that the Village may wish to participate in for the expressed purpose of educating employees.

Ensure routine maintenance of all infrastructure components – routine maintenance is a key to energy efficiency and will ensure that all equipment is optimized for peak performance, while using less energy. This includes cleaning of ducts, checking of motors, and reviewing controls to ensure they are set properly.

Village of PEMBERTON

URBAN systems

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

5.2 Buildings

Use of heat and power in municipal buildings results in significant energy expenditures and, in the case of the Public Works building, results in significant greenhouse gas emissions. Given the age of the buildings, and the expectation that many of these buildings will be replaced over time, it is important to that the level of investment in improving energy efficiency in existing buildings is appropriate. Efforts to reduce energy consumption and greenhouse gas emissions from municipal buildings should be considered. Initiatives include:

Ensure future buildings are energy efficient – given the age of the Village's main buildings, it is anticipated that these will be replaced in the next 10 – 15 years, if not sooner. It will be important that new buildings be designed to be energy efficient.

Review envelope improvements at the municipal offices and other buildings – the Village spends approximately $7500 per year on energy for the municipal offices. One of the key considerations in making the building more energy efficient is to consider improvements to building envelopes.

Improvements can include treatments for doors and windows as well as walls and the roof. Performed as part of a building audit, a review of the building envelope will identify where there are significant leaks that will cause heating and cooling systems to run inefficiently and recommend options to reduce these losses. Improvements can include better insulation in walls and for the roof and glazing for windows, provision of insulating shades, or replacement with low-emissivity windows. An energy audit should be done at each of the buildings to determine what investments should be made in insulation, windows, and doors.

Review energy efficiency opportunities at Public Works building – approximately $21,000 was spent on energy for the Public Works building in 2011. A number of potential improvements should be reviewed. These include:

- Overall building envelope – the building envelope, including insulation, windows, and doors should be reviewed to determine how it can be made more energy efficient. This could also review the insulation of garage doors.
- Potential for construction of small office and clean room in the shop – ensure that there is focus on heating the parts of the building that need heating and reduce heating in areas, such as the garage, that do not need heating.
- Ensure garage doors are closed – given the inefficiency of heating the Public Works building, it is critical that garage doors remain closed whenever it is not in use.

Village of PEMBERTON

URBAN systems

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

Optimize hot water heating – hot water heating can result in significant energy usage but also significant opportunity for energy savings. For facilities, it is wise to examine optimizing the performance of the existing hot water tank. Turning down the temperature of the hot water heating can result in small, but significant savings. According to the American Council for an Energy Efficient Economy, for each 10ºF reduction in water temperature, savings of 3%–5% of water heating energy costs can be achieved.

If a new hot water system is to be considered, there are other options for hot water that can be examined. Tankless water heaters and solar hot water heating systems can offer significant energy savings depending on the demand for hot water. Tankless water heaters would be particularly effective at the municipal office and Public Works building where hot water needs are low. This should be considered when hot water boilers require replacement.

Review ventilation requirements - substantial amounts of energy can be saved when reviewing ventilation requirements. Ventilation, in many buildings, is one of the greatest users of electricity and there are many opportunities to improve ventilation performance. A simple method is to install room controls for ventilation to ensure that the ventilation system is only used when the room is in use. Carbon dioxide (CO_2) sensors and other occupancy sensors can be used to monitor the number of people in a room and adjust ventilation to facilitate good indoor air quality. CO_2 sensors are particularly useful in larger rooms that have infrequent use such as a theatre, dressing rooms in arenas and gymnasiums, boardrooms and other similarly used rooms. Further optimizing the ventilation system to better match actual requirements can result in significant electricity savings. A further simple step is to ensure air filters are cleaned routinely as dirty air filters adversely impact efficiency.

Review air conditioning – it is likely that many of the buildings rely on some form of air conditioning for cooling needs. Regular maintenance of filters and coils on the air conditioning unit as well as cleaning ducts periodically will help ensure that the existing system will operate efficiently. Ensuring that ducts are airtight is also important to central air conditioning performance.

Turn it down/Turn it off campaign – one area where there can be more effective use of energy is to implement turn-it-down/turn-it-off campaigns. This is particularly useful for lighting, and to a lesser extent, computers and other office equipment. Employees should be educated to turn lights, computers, and other pieces of equipment off while not in use. As well, there should be a review of whether certain pieces of equipment are necessary. Examining whether air conditioning and heating could be turned down would also help to reduce energy usage. With both heating and cooling, ensuring that controls are set to be mindful of when people are using buildings is an important consideration. For example, heating and air conditioning should be turned down during the evenings and weekends when buildings are not in use. Adopting a philosophy of heating and cooling people, and not space, is important. Hallways, stairwells, and other corridors do not have the same heating and cooling requirements as offices and meeting areas.

The Village should also work to reduce any "phantom loads", which is the electricity used to keep an appliance or other piece of equipment in stand-by mode or to power internal and/or external clocks, even when the appliance is not in actual use. To demonstrate the magnitude of phantom loads, the average microwave uses more energy, over the course of a year, to operate the digital clock than to operate the microwave itself. While these loads are not overly significant at an individual level, cumulatively they can have an impact on energy usage. The largest likely impact for the Village would be the use of computers which often times are left on at night. Turning the computers off at night and/or having an auto-sleep program for the computer will help reduce electricity use.

Replace office equipment – having an office equipment replacement initiative that encourages energy efficiency when existing equipment becomes obsolete will help the Village evolve to a more energy efficient workplace. Taking advantage of obsolescence cycles for equipment will allow the Village to make changes incrementally rather than investing all at once. If the Village is to replace the equipment anyway, the small premium that may be required to obtain the more efficient product will be easier to manage. However, depending on the type of equipment, and the age of the existing equipment, it may in fact be more cost effective from energy, operations, and maintenance perspectives to replace it immediately rather than waiting for the end of useful life.

When replacing equipment, the emphasis should be on purchasing products that result in significant energy efficiency. A two-step thought process related to purchases should be considered. First, the Village should look at the size of equipment being used – i.e. is a 20 cu. ft fridge necessary when a 12 cu. ft fridge would suffice. Right-sizing equipment will ensure that the Village is not wasting energy on unused capacity. Second, the Village should look for the most energy efficient product available at the desired size. This replacement scheme should be applied to computers, televisions, appliances (i.e. in staffrooms), etc. Using the EnergyStar system as a guide for the purchase of equipment could help in this regard.

Review interior lighting needs – many office buildings were developed using standards for lighting that have long been outdated due to the ambient light created by items such as computers. An illumination standard of 100 foot candles is typically used for offices when 30 foot candles often suffices. Reviewing these lighting needs will likely result in less lighting being required and therefore electricity savings.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

As a first step, interior lights that are using incandescent light bulbs should be replaced. This includes replacing exit signs with LED lighting which uses 90% less electricity and last 10 – 25 years as well as any lamps and other lighting fixtures that could be replaced with compact fluorescent bulbs (CFLs). CFLs will save between 50 and 75% in annual lighting costs over incandescent bulbs. Even though these bulbs are initially more expensive, they give off less heat and last up to ten times longer than incandescent ones.

Standard fluorescent tube lighting has also evolved, particularly with respect to the ballast, to reduce energy consumption. Switching ballasts can reduce lighting energy by as much as 35%. A building audit through BC Hydro will take note of such issues.

An additional step would be to install occupancy sensors in rooms that are not used often but have higher periodic lighting needs. This would include rooms such as bathrooms, safe room, public bathroom at the white building and lunch rooms.

5.3 Infrastructure

Infrastructure includes water and sewer infrastructure and community lighting. These components largely use electricity to operate.

5.3.1 Water and Sewer

As summarized in **Section 4.5**, the linkage between water consumed and energy consumed is very high. Finding options to reduce the amount of water processed has a strong likelihood of reducing energy consumption. Improvements in energy efficiency for water and sewer infrastructure include:

Develop and implement a water conservation program **–** the Village should review options to reduce demand for water, particularly in the summer months. Options such as outdoor water restrictions in the summer months, offering low flush toilet rebates, and continual education programs can all help in reducing water consumption. The Village should take a lead by ensuring all municipally-owned facilities use low flow fixtures and toilets. The Village could also reconsider the feasibility of water meters given the benefits these have to water conservation in addition to providing a better understanding of the system.

Undertake leak detection – a leak detection and remediation program would enable the Village to understand where water losses are occurring in their water distribution system. This could be related to the development of an asset management program which would enable the Village to better understand where future investments should be made.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

Review possibility for pressure reduction – often times when there are leaks in a water distribution system, they are exacerbated by having water pressures that are higher than what are necessary. The Village should review the possibility of reducing leaks in their water system to reduce the potential for water losses. Reducing water pressure can also extend the useful life of the infrastructure, thus reducing the need for asset rehabilitation.

Review of inflow and infiltration – a recommendation from the staff survey was to review inflow and infiltration in the sewer system to ensure that the Village is not treating stormwater and groundwater unnecessarily at the Sewage Treatment Plant and thus reducing the efficiency of sewage treatment.

5.3.2 *Lighting*

Much of the outdoor street lighting in Pemberton is owned and maintained by BC Hydro which leases the lights to the Village. However, ornamental street lighting is owned by the Village, and costs approximately $7000 per year to operate. Options to reduce energy consumption on lighting include:

Install light sensors so lights are only used when needed – adding light sensors to lights will enable them to come to full brightness only when they are needed (i.e. when someone is walking or driving down the street). Some systems can reduce energy consumption by up to 80%. They are also beneficial as they contribute to 'dark skies' initiatives which seek to reduce light pollution.

Explore the use of LED lighting on outdoor ornamental lights – LED lights can offer significant energy savings over traditional light bulbs and generally have much longer life, thus requiring less maintenance.

5.4 Fleet

Fuels used for fleet and equipment result in significant Pemberton's highest greenhouse gas emissions. Initiatives to reduce the amount of fuel used for fleet and equipment include:

Develop a tire pressure monitoring program – a Tire Pressure Program would direct vehicle users and maintenance staff to maintain vehicle tire pressures in their optimum pressure range. In Olympia, Washington, the Department of Public Works was able to achieve fuel savings in the range of 20% by having tire pressure checked regularly (i.e. weekly). Olympia is now beginning to install computerized tire pressure gauges in many of their vehicles to provide more real-time information on tire pressure. According to Natural Resources Canada, each tire that is under–inflated by 2 psi (14 kPa) causes a 1% increase in fuel consumption.

Develop a monitoring program for the fleet - the Village should collect or interpolate data relating to:

- Vehicles and equipment classified by description;
- Engine size;
- Gross vehicle weight rating;
- Litres/100 km;
- Type of fuel;
- Annual kilometers driven;
- Average cost per litre of fuel;
- Total fuel consumption per vehicle;
- Average fuel cost per kilometer driven;
- Frequency of tune-ups; and
- Carbon dioxide calculation based on fuel use.

By developing this monitoring program the Village will be able to determine what vehicles are operating inefficiently and seek steps to rectify the situation. This data should be updated on a yearly basis in order to calculate impacts from vehicle usage, both to determine cost of vehicle operation and to determine the level of GHG emissions. It is understood that the Village is using software that will better track vehicle fuel usage and will enable the Village to track fuel usage by vehicle rather than in its aggregate form.

Right-size vehicles and optimize their use – the Village should examine its vehicle fleet and ensure that vehicles are being used appropriately. This assessment would look at whether vehicles are being used for the right tasks – for example not using a large pickup truck to drive to meetings, and whether vehicles are the appropriately sized engines – not having engines that are larger than necessary. Further, the Village should look at daily tasks and determine the most efficient means, from a travel perspective, to accomplish these tasks. Therefore, staff would be encouraged to combine trips wherever practical to achieve efficiencies in operation.

Develop a driver education program – the Village should develop and/or participate in a driver education program that will teach employees on how to drive more fuel efficiently. The program would address issues such as cold weather starts, idling, stopping and going on the road network, vehicle maintenance, and other matters. These have the potential to be low cost initiatives that have significant benefit and could spread throughout the community.

5.5 Alternative Energy

While likely more expensive than some of the other initiatives suggested in this report, Pemberton should consider the use of alternative energy for their facilities and potentially to provide energy to other community facilities. Potential initiatives include:

***District energy for municipal buildings* –** given the presence of several municipal/SLRD buildings in close proximity to one another on Prospect Street and Aster Street, there may be an opportunity for a district energy system. This could reduce long-term energy expenditures for this area and enable the use of energy resulting in fewer greenhouse gas emissions. A screening assessment could be undertaken to review the general potential for this opportunity and to determine if a full feasibility study is warranted. This would support the Village's OCP policy to encourage and support biomass energy systems and to encourage alternative energy supplies. The Village could consider how alternate sources of funding could be used to fund the screening assessment.

***Consider alternate sources of heating* –** there are two alternate sources of heating and cooling that have become more popular in recent years. These include geothermal and solar thermal heating. Geothermal is an efficient and generally clean way to heat and cool buildings. Geothermal energy involves drilling loops of pipe into the ground to use the earth's constant temperature to provide heating and cooling. In the winter, the heat from the earth is carried into buildings through the loop system while in the summer heat from the building is extracted and sent into the ground, while cool air is brought in. The systems are also typically used to heat water. Geothermal systems generally come in two systems – open loop and closed loop. In an open loop system, two unconnected pipes are drilled into the ground and generally into an aquifer. Water from the aquifer is pumped up and through a heat exchanger and is then condensed and distributed throughout a building. Once the water cycles through the system it is discharged back into the aquifer. In a closed loop system, a solution such as glycol is used to transfer heat from the ground and into the heat exchanger where it is distributed and sent back into the ground to be pumped up again.

While geothermal systems typically have high initial capital costs, the payback period for the investment can be relatively quick. It is important to note, however, that a geothermal system is more difficult to implement in an existing building and can become cost prohibitive depending on the accessibility to an area for the loops.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

Solar thermal systems, while mainly focusing on heating water, can be expanded for space heating as well. Options include typical solar panels combined with a heating distribution systems and solar walls, which collect heat and distribute this through the ventilation systems.

Table 5.1 summarizes each of the options in terms of priority for moving forward.

Table 6.1: Implementation Summary

Initiative	Type	Level of Investment	Level of Impact to Energy Use/Cost	Level of Impact to GHG Emissions	Priority
Organizational					
Develop Council awareness of corporate energy issues	Organizational	Low – Moderate	N/A	N/A	High
Develop Council policies – emissions and energy reduction targets, carbon neutrality, procurement	Organizational	Low – Moderate	N/A	N/A	High
Provide employee education opportunities	Organizational	Low - Moderate	N/A	N/A	High
Ensure routine maintenance of all infrastructure and fleet components	Energy Conservation	Low	N/A – maintain energy efficiency	N/A	High
Buildings					
Ensure future Village-owned buildings are energy efficient	Organizational	Low			
Review envelope improvements at the municipal offices	Energy conservation	Moderate – high (likely >$10,000 per building)	Reduce energy consumption 10 – 15% (savings of approximately of approximately $700 - $1000 per year)	Low – buildings are heated with electricity	Moderate
Review energy efficiency opportunities at Public Works building	Energy conservation	Moderate – High (likely $20,000 - $30,000)	Reduce energy consumption – 10 – 15% (up to $2000 per year)	Moderate	Moderate
Optimize hot water heating – turn down heaters and insulate pipes	Behavioural	Low	Low – approximately 2 – 5% at each building	Low, except at the Public Works building where water is heated using propane	High
Switch to tankless water heaters for smaller hot water users such as at the Municipal Hall and Public Works Building	Alternate technology	Moderate	Low – 5%	Moderate	Low
Ventilation – occupancy sensors	Energy conservation	Low - moderate	Moderate – High	Low	Moderate
Ventilation – room controls	Energy conservation	Low - moderate	Moderate – High	Low	Moderate
Review air conditioning needs	Energy conservation	Moderate			
Turn-it-down/Turn-it-off campaign	Behavioural	Low	Low – Moderate	Low – Moderate	High
Replace office equipment	Energy conservation	Moderate	Low – Moderate	Low	Low
Review interior lighting needs	Behavioural	Low	Low – Moderate	Low	High
Install appropriate heating control devices	Energy conservation	Low	Moderate	Low – Moderate	High
Infrastructure					
Develop and implement a water conservation program	Energy conservation	Moderate	Moderate - High	Low	High
Undertake leak detection	Energy conservation	Moderate	Moderate - High	Low	High
Review possibility for pressure reduction	Energy conservation	Low	Moderate	Low	Moderate
Review of inflow and infiltration	Energy conservation	High	Moderate	Low	Low
Install light sensors	Energy conservation	Moderate	Low	Low	Low
Explore the use of LED lighting on outdoor ornamental lights	Energy conservation	Moderate – high	Moderate – high	Low	Moderate
Fleet and Equipment					
Develop a tire pressure monitoring program	Behavioural	Low	Moderate	Moderate	High
Develop fleet monitoring program	Behavioural	Low	Low	Low	High
Right-size vehicles and optimize their use	Energy conservation	Moderate – High	Moderate	Moderate	Moderate
Develop a driver education program	Energy conservation	Low	Moderate	Moderate	High
Integrated Resource Management					
District heating and cooling	Alternative Technology	High	Moderate – High	High	Low
Consider alternate sources of heating	Alternative Technology	High	Moderate-High	High	Low

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

6.0 Moving Forward

This report has presented a number of options for Pemberton to consider reducing its corporate energy consumption and greenhouse gas emissions. There are opportunities to reduce the Village's exposure to expected changes in energy prices and to be a leader in the community in reducing greenhouse gas emissions.

It is important to recognize that while there are likely some opportunities to reduce energy costs and greenhouse gas emissions, it is likely best to undertake the more significant energy efficiency upgrades in conjunction with asset management. In terms of moving forward over the course of the next year, the key priorities include the following:

Undertake organizational initiatives – a number of organizational issues have been proposed, such as ensuring that there is a framework in place to collect, analyze and report data relating to energy consumption and emissions. In addition, providing educational opportunities for staff is important so that they can learn how they can assist with reducing energy consumption and greenhouse gas emissions.

Develop an asset management plan – an asset management plan will enable the Village to determine when future investments will be made into infrastructure and buildings. By doing this, the Village will be able to ensure that investments in asset rehabilitation are made with energy efficiency in mind and will be able to leverage their investments to the fullest extent.

Reduce water consumption – the Village should enhance its existing water conservation efforts to reduce energy consumption, including water restrictions in the summer and ensuring that Village water is not being used to irrigate large parcels. In addition, the Village should undertake leak detection programs and look at fixing leaks in the distribution system.

Undertake building audits – the Village should work with BC Hydro to undertake building energy audits of key facilities such as the Public Works building and municipal offices. The Village should discuss this with their BC Hydro account manager.

Develop fleet and equipment data tracking system – a large proportion of the Village's energy costs and emissions are from the use of transportation fuels. Developing a method to track and analyze fleet and equipment fuel usage in greater detail to determine how improvements could be made and to ensure that vehicles are achieving key performance standards. In this sense, the Village should consider how to standardize administration and monitoring of energy accounts.

Beyond the first year of the implementation of the options, Pemberton should consider how they want to invest in energy efficiency upgrades. This could be simple initiatives such as replacing equipment to more substantial investments such as reviewing the feasibility of district energy systems.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

Appendix A

Understanding Energy and Greenhouse Gas Emissions

1.0 Understanding Energy and Greenhouse Gas Emissions

There are three principal sources of energy that the Village consumes in an active manner. These include electricity provided by BC Hydro; propane, which is burned to generate heat for water and interior space; and gasoline and diesel provided by various sources, which is used to create mechanical energy. These sources of energy have different costs and GHG emissions associated with them. Before analyzing energy use, it is important to review the types of energy and their associated costs and impacts on GHG emissions in the BC context. Carbon tax implications are discussed in greater detail in later sections of the report.

1.1 Electricity

Currently, the Village of Pemberton's electrical needs are met through BC Hydro. The majority of electricity that BC Hydro provides comes from hydro-electric dams which are generally considered "clean" sources, excluding the initial environmental damage of constructing new dams and reservoirs. This also excludes the potential methane emissions that result from decomposing organic material in reservoirs, which has been found to be quite significant in some instances. BC Hydro also imports a portion of its electricity from Alberta and American states through its subsidiary – Powerex (BC Hydro 2009 Annual Report). According to the Alberta Electric System Operator website, Alberta generates a significant amount of electricity from natural gas and coal (http://www.aeso.ca/ourcompany/15771.html).

1.1.1 *Cost of Electricity*

BC Hydro separates its electricity rates by commercial and residential use. There are two types of rate categories that apply to facilities owned by the Village of Pemberton. They include:

Small General Service Rate

These facilities have an annual peak demand of less than 35 kW. Facilities such as the municipal hall and street lighting would fit in this category. The small general service rate structure is summarized in **Table 1.1.**

Table 1.1: Small General Service Rate

Basic Charge	$0.1925 per day
Energy Charge	$0.0915 per kWh
Minimum Charge	$0.1925 per day (equal to the Basic Charge)
Discounts	1.5% on entire bill if customer's electricity is metered at primary potential $0.25 per kW if customer supplies transformation from a primary to a secondary potential If a customer is entitled to both discounts the 1.5% discount is applied first
Rate Rider:	5% Rate Rider applied to all charges, before taxes and levies

Source: BC Hydro Website

Medium General Service Conservation Rate

Facilities in this rate category have an annual peak demand between 85 and 150 kW. Facilities that would fall into this category include water pump stations. The medium general service conservation rate structure is summarized in **Table 1.2.**

Table 1.2: Medium General Service Conservation Rate Structure

Basic Charge	$0.1925 per day
Demand Charge	$0.00 per kW for first 35 kW $4.69 per kW for next 115 kW $9.00 per kW for remaining kW
Energy Charge	Part 1: $0.0897 per kWh for last 14,800 kWh $0.0490 per kWh for remaining kWh up to baseline
	Part 2: $0.0942 per kWh for usage up to 20% above baseline $0.0942 per kWh for savings down to 20% below baseline (credit) Usage or savings beyond 20% of baseline are based on Part 1 prices
Discounts	1.5% on entire bill if customer's electricity is metered at primary potential $0.25 per kW if customer supplies transformation from a primary to a secondary

	potential If a customer is entitled to both discounts the 1.5% discount is applied first
Monthly Minimum Charge	50% of the highest maximum demand charge billed in any month within an on-peak period (1 November to 31 March inclusive) during the preceding 11 months
Minimum Energy Charge	$0.0281 per kWh applies when the Energy Charge (Part 1 and 2) divided by the total kWh is less than $0.0281 per kWh
Rate Rider	5% Rate Rider applied to all charges, before taxes and levies

Source: BC Hydro Website

In 2007, the BC government released its Energy Plan which indicated that the province is to be electricity self-sufficient by 2016, based on average water levels, with 50% of BC Hydro's incremental need for electricity coming through conservation by 2020. Further, all electricity will be required to come from carbon neutral sources such as hydro-electric dams and renewable energy sources such as wind, solar, and tidal energy.

To support the conservation efforts, it is inevitable that there will be increases in prices for electricity to encourage demand management. Electricity rates in the last few years have increased significantly, and are expected to increase 8% for the current fiscal year and 3.9% for each of the following two fiscal years.

1.1.2 *Relationship to Greenhouse Gas Emissions*

Currently, BC Hydro indicates that approximately 90% of the electricity generated by BC Hydro is from hydro-electric dams. As mentioned previously, while most of BC's electricity is considered clean, from a GHG emission perspective, it is notable that the province still imports some electricity from other jurisdictions which rely on more carbon producing sources of electricity generation. However, there may be cause for concern that hydro-electric dams actually result in significant greenhouse gas emissions. According to an article published by the New Scientist magazine entitled *Hydroelectric power's dirty secret revealed (February 2005),* there is reason to believe that hydro-electric dams contribute to GHG emissions through the decomposition of organic matter in reservoirs. The extent of this contribution varies greatly depending on the manner in which the reservoir was constructed and its location. However, the important point is that hydro-electricity, which forms the vast majority of BC's electrical resources, cannot be relied upon to be completely GHG emission free and thus there is merit to reducing electricity usage beyond reducing costs.

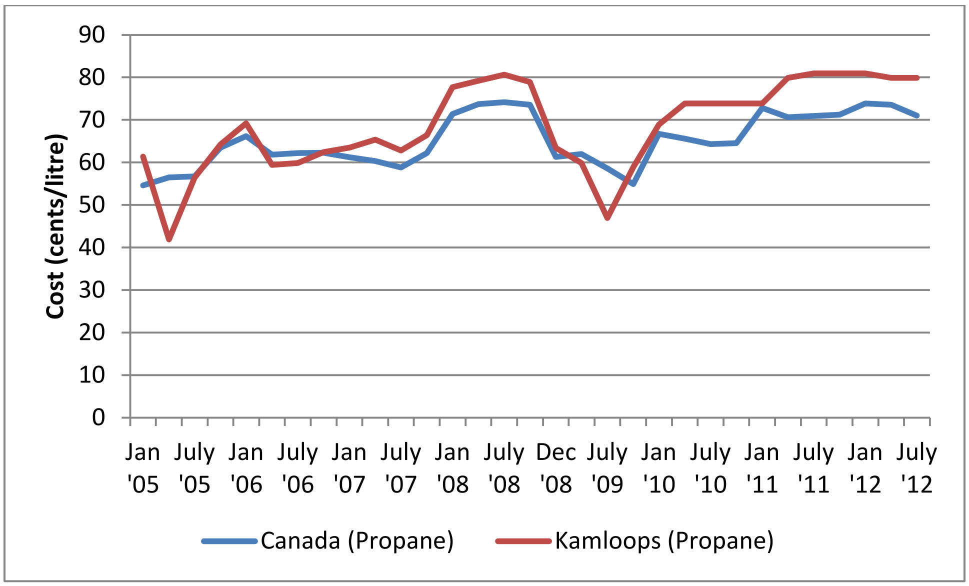
Based on the *Methodology for Reporting 2011 BC Public Sector Greenhouse Gas Emissions Version 2.0*, the greenhouse gas emissions from electricity generated in BC was 25 tonnes CO_2E/GWh. This does not include electricity imported from other jurisdictions, such as Alberta, so the actual amount is higher.

1.2 Propane

Propane is derived is a produced as a by-product of two other processes – natural gas processing and petroleum refining (Wikipedia). Currently the Village of Pemberton obtains its propane from Superior Propane. Propane in Pemberton is used for heating purposes at the Public Works.

1.2.1 Cost of Propane

Given that propane is a by-product of petroleum refining, the price of propane is greatly influenced by crude oil prices. In addition, given its use as a heating fuel, it often fluctuates in price due to changes in weather (i.e. colder weather creating more demand). However, it is important to note that the cost of propane, over the long-term, has not fluctuated at the same level as other fossil fuels. **Figure X** illustrates changes in propane costs.



1.2.2 Relationship to Greenhouse Gas Emissions

Buildings in BC are a significant contributor to greenhouse gas emissions. For the Village of Pemberton, propane is used to heat one building. The emission factor for propane is 0.00154 tonnes CO2E /litre.

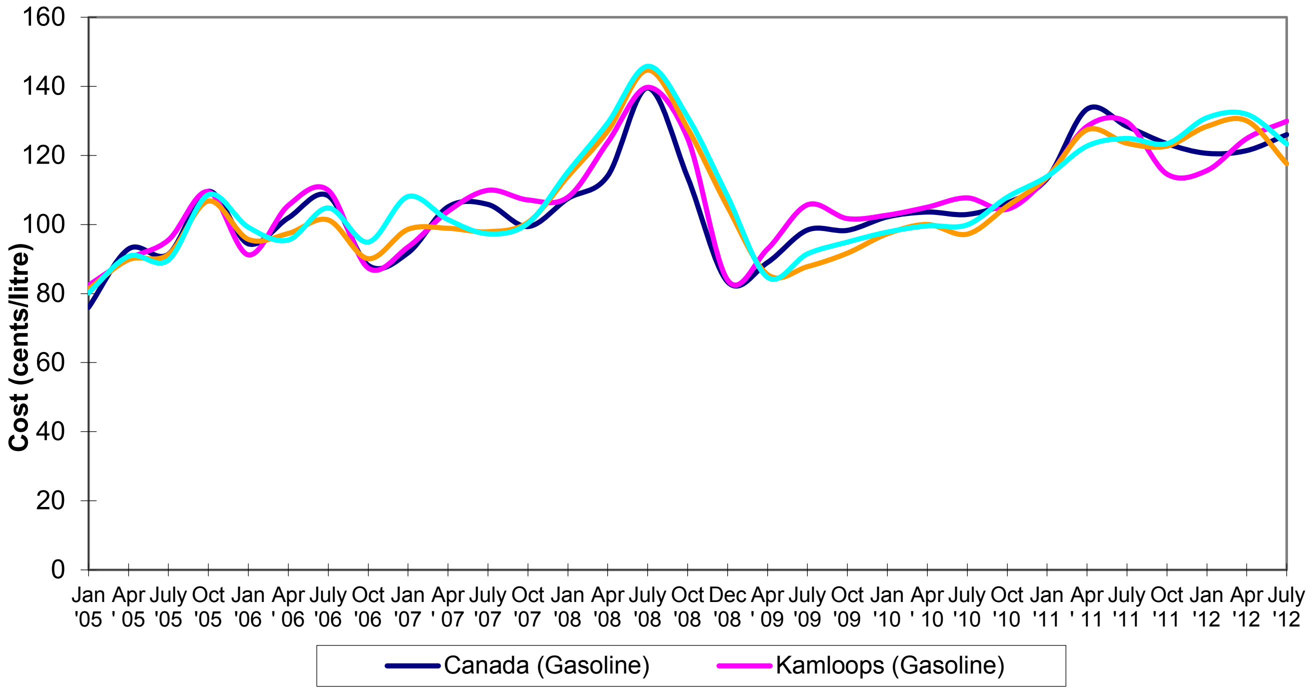
1.3 Petroleum Products

Petroleum products are used as an energy source principally for transportation needs and equipment through gasoline and diesel.

1.3.1 Cost of Fuel

There has been significant volatility in the cost of fuel over the past number of years. This has been due to volatility and political instability in nations that supply oil, increased demand from developing countries such as China and India, as well as concerns that world supplies of oil have reached their peak and that the remaining supply for the next few decades will come from areas where the oil is typically less cost effective to access. Despite the economic downturn, there have still been fluctuations in gas and diesel prices. **Figure 2.1** summarizes average petroleum costs since 2005 for both Canada and the Kamloops market, which likely best reflects the Pemberton market.

Figure 2.1 – Petroleum Costs (2005 – 2012)



Source: Natural Resources Canada – Fuel Focus Report

1.3.2 Relationship to Greenhouse Gas Emissions

There have been numerous advances in automobile technology to reduce greenhouse gas emissions. These include hybrid vehicles, use of biodiesel, and limited roll-out of natural gas and electric vehicles. Further, the range of automobiles that are available continues to evolve with a number of smaller automobiles available, such as SMART cars, which can serve urban needs. Looking forward, plug-in hybrid vehicles and hydrogen vehicles may become marketable soon. These will be dependent on advances in battery technology and fuel cells.

Advances to improve petroleum use and GHG emissions have occurred but there are still significant concerns with the roll-out of technology and its overall level of impact. For example, biofuels can contribute to reduced greenhouse gas emissions from the tailpipe of vehicles. However, according to a report published by the United Nations entitled *Sustainable Bioenergy: A Framework for Decision Makers (2007)*, some biofuels can even result in greater life-cycle GHG emissions than traditional petroleum products due to the amount of energy used to produce the fuel as well as the loss of carbon sinks through land clearing. Market trends have also shown that producing biofuels is displacing food crops to a large extent contributing to higher food prices. The 2012 drought in the American Midwest exacerbated the issue as American ethanol requirements stipulated that a significant proportion of corn crops were to go to creating fuel leaving less corn to support the food system. Next generation biofuels, which are being derived from non-food crops, offer more promise in reducing social costs, but the impact on life-cycle GHG emissions is still questionable.

There are also issues with hybrid vehicles in that fuel efficiency is largely a determinant of the driver habits, the terrain being travelled in, and whether driving is predominantly on urban roads, where there is greater efficiency as auxiliary power is used, or on highways, where there is less efficiency as primarily gasoline is used for power.

In general, diesel engines provide more power per unit of energy consumed than gasoline engines. Four-stroke engines are generally more efficient than two-stroke engines as there is a more complete burning of fuel and no need to burn oil as part of the process. Two-stroke engines are popular due to their simple design and their power-to-weight ratio which explains their popularity for chainsaws, lawnmowers, etc.

Based on the BC Greenhouse Gas Emission Assessment Guide, diesel fuel produces 0.00276 tonnes of CO_2E /litre while gasoline fuel produces 0.00241 tonnes of CO_2E /litre. For context, if a 40 litre tank of gas is burned, it will produce the equivalent weight of emissions of fully grown, large man (approximately 210 lbs).

1.4 Summary

As can be seen in the analysis of the various energy sources, energy prices have increased significantly in the recent past. It is not expected, over the long-term, that these increasing prices will abate, particularly for petroleum products, despite recent downward fluctuations in fuel prices.

An interesting component of energy that is explored further in this report is the fact that reducing energy use is not necessarily linked to reducing GHG emissions. As evident in the preceding sections, energy supplied through electricity results in substantially fewer GHG emissions than natural gas or petroleum products. Therefore, it is important to understand what the priorities are in terms of addressing energy use – reducing cost, reducing GHG emissions, or striking a balance between the two. This will guide future investments into the Village's energy management practices.

REPORT

Corporate Energy and Emissions Study

2512.0005.01

March 2013

Appendix B

Review of Impact of Proposed Initiatives

Village of PEMBERTON

URBAN systems

Summary of Impacts of Proposed Initiatives

A number of recommendations have been made that would allow the Village to reduce energy consumption, costs, and greenhouse gas emissions. In order to develop targets for reductions, a cursory review was undertaken to determine what reduction targets appeared feasible. **Table 1** summarizes each of the proposed activities in terms of their potential for energy reduction, emissions reductions, and costs savings. It is important to note that further, more in-depth analysis would be required to verify the impact of each of these initiatives.

Table 1: Summary of Impacts of Proposed Initiatives

	Energy Reduction	**Emissions Reduction**	**Cost Savings**
	Buildings		
Envelope Improvements – Municipal Hall	15% (11,000 kwh)	0.3 tonnes	$1100 per year
Envelope Improvements – Public Works Building	15% (approximately 3000 L reduction in propane fuel)	4 – 5 tonne	$2,800
Optimize Hot Water at Buildings	2% (3700 kwh, 400 L of propane)	0.7 tonnes	$800
Ventilation improvements	5% (9300 kwh)	0.2 tonnes	$900
Behavioural Change	1% (1850 kwh)	0.05 tonnes	$200
Small conservation programs	2% (2700 kwh, 400 L of propane)	0.7 tonnes	$800
	Water and Sewer Utilities		
Water conservation	10% (38,500 kwh)	1 tonne	$3400
Leak Detection	10% (38,500 kwh)	1 tonne	$3400
Pressure Reduction	2% (7,700 kwh)	0.2 tonnes	$700
Fix Inflow and Infiltration	2% (7,600 kwh)	0.2 tonnes	$700
	Lighting		
Light sensors on ornamental lights	5% (4000 kwh)	0.1 tonnes	$350
LED lights on ornamental lights	25% (20,000 kwh)	0.5 tonnes	$1750
	Fleet and Equipment		
Various Initiatives	5% (490 litres of gasoline, 880 litres of diesel)	3.6 tonnes	$1,650
Total	144,850 kwh electricity 3800 L propane 490 L gasoline 880 L diesel 670 GJ reduction	12.5 tonnes	$18,550

Based on the initiatives reviewed in **Table 1**, the Village is in a position to reduce its corporate greenhouse gas emissions by approximately 10% and reduce its overall energy consumption by approximately 15%.