


Regional District Central Kootenay Area 'D' and Kaslo Green Energy Opportunities Scan

December 2016

The 'first stop' for local government leaders addressing energy sustainability and climate change

Connecting communities, energy and sustainability

Community Energy Association

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Executive Summary

This document summarizes the findings of a high level review of potential renewable energy options by the Community Energy Association (CEA) in RDCK Area D and Kaslo. It is intended to provide a basic screening of renewable energy options and identify technologies and specific opportunities that warrant further study. It include several projects already short listed in the area.

1. Biomass in conjunction with the regional/basin wide initiatives looking at commercial CHP and residential heating with pellets
2. Micro Hydro on the Kaslo water system at either the reservoir inlet or inline at the PRV station downstream of the water treatment plant
3. Solar farm in the Lardeau Valley (2 locations)
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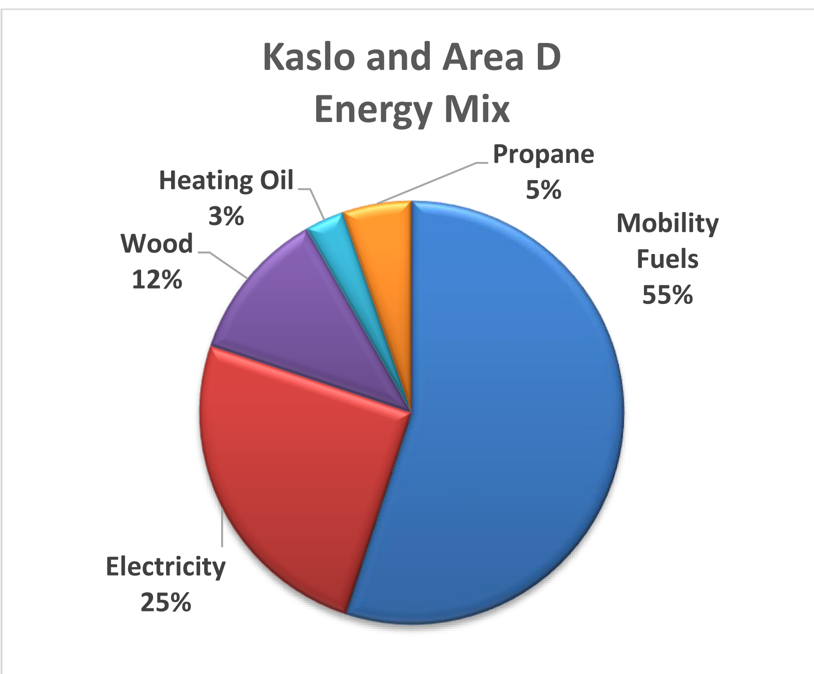
5. Direct supports for individual households to do their own renewable energy initiatives

Data for the energy & emissions from communities can be found in the Province's Community Energy & Emissions Inventories (CEEI). Area D and Kaslo do not have access to natural gas, which is less expensive than propane or heating oil. The typical per capita energy consumption & emissions profile for Area D and Kaslo are similar. Estimated cost per capita on energy based on 2012 population data and current energy cost is about $4500/year and a combined community energy spend of just over $14 million.



Hamill Creek Timber and Boards by George were identified as Combined Heat and Power (CHP) sites. Hamill Creek Timber represents the best location for a small scale CHP system based on the biomass fuel they produce as well as heat and electricity demand. There may also be potential for some sales of electricity to BC Hydro under the net metering programs. The capital for a potential system ranges from $250-700,000. There are a variety of potential ownership models but given the current market conditions it would be simplest and best option if the system was owned and operated by Hamill Creek Timber with support from the Regional District.

The village of Kaslo has an excellent opportunity to reduce their electricity costs at their water reservoir by installing a micro hydro system at the inlet to the reservoir as well as on their main PRV prior to the treatment plant. Both systems would be similar in size but with the reservoir system being similar to Nakusp's system and the PRV being an inline system. The challenge is that both systems are located in the Fortis Electric territory. The Fortis Electric net metering system is designed only to reduce electricity consumption and not revenue generation. Both systems can be done separately but given their similar nature synergies in terms of construction and operation should be achievable. Kaslo staff expressed concerns about their capacity to operate a renewable energy system. A combined system may represent a better case for forming partnerships to complete the project. Potential partners could be Nelson Hydro or local professionals. The total cost of both projects would be approximately $70-90,000. Depending on the electricity displaced by the projects the village and if revenue is generated the result could be any where from $20,000 in savings or $12,000 in revenue or a combination of both depending on the exact configuration and partnership model.

There is the potential for two solar projects in the Lardeau Valley. One at Jewett school and the other at Meadow Creek Hall. Both buildings are BC Hydro customers and would qualify for their net metering program. The most likely scenarios is that the projects would be some form of cooperative community project similar in nature to Nelson's Solar Garden. It is estimated that both locations could support a ground based 20 kW fixed solar array. The electricity would be used to reduce the electricity required to operate both facilities and potentially generate some revenue. The cost of each project would be approximately $20,000 for the solar panels plus an additional $10,000 each to install them. This is based on leveraging local skills and resources to reduce the installation costs. Each system could have the potential to generate $3500 a year in revenue assuming all of the electricity was sold to the grid but it is expected that a significant portion of the energy produced would be used to displace BC Hydro electricity. The result is lower operations costs for both facilities.
The Kaslo Aerodrome was also evaluated and discounted. The aerodrome has good solar potential but the potential business model was poor. The aerodrome is located in the Fortis Electric area and Fortis' net metering program is designed to reduce electric demand and not generate revenue. There is no customer identified on site that could benefit rom the solar electricity produced it was deemed not

appropriate at this time. This should be re-evaluated in the event significant development takes place at the aerodrome.

The following chart shows how ready the project is to be implemented, the impact it will have on the community, how much it will contribute to the sustainability of the community and how much of a role there is for local government. Green is positive yellow is neutral and red is not significant.

Project	**Implementation**	**Impact**	**Sustainability**	**Role for LG**
Biomass Combined Heat and Power				
Biomass Heating with Pellets				
Kaslo Water Reservoir				
Kaslo Pressure Reducing System				
Kaslo Aggregated Hydro				
Lardeau Valley Solar Farm				
Kaslo Aerodrome				
Cash Rebates to Residents				
Energy Efficiency				
Revitalization Tax Exemptions				

As part of this research CEA evaluated opportunities for the Regional District and Village of Kaslo to influence residential energy. The best outcome is for the local government to partner with BC Hydro and Fortis to encourage energy efficiency. This results in less energy consumed locally and therefore more savings for residents, which they can be spent elsewhere. CEA also looked at the opportunity to provide incentives for local residents to produce there own renewable energy. The following chart shows the impact of various renewable energy technologies for residential use based on conditions in the home.

Technology	Residential Conditions	Revenue Generation	Energy Savings	GHG Savings	Energy Independence
Solar PV	Grid Tied – BC Hydro				
	Grid Tied - Fortis				
	Off Grid				
Wind	Grid Tied – BC Hydro				
	Grid Tied - Fortis				
	Off Grid				

Micro Hydro	Grid Tied – BC Hydro				
	Grid Tied - Fortis				
	Off Grid				
Solar Thermal	Propane/Fuel Oil Hot Water				
	Electric Hot Water				
Pellet/Wood Chip Heating	Propane/Fuel Oil Heat				
	Electric Heat				
Air Source Heat Pumps	Propane/Fuel Oil Heat				
	Electric Heat				
Geothermal Heat	Propane/Fuel Oil Heat				
	Electric Heat				

In addition to rebates the Village of Kaslo could provide tax exemptions under the Revitalization Tax Exemption program for municipalities. This option is not available for residents living in Area D and is more difficult to administer.

The following are highly recommended as next steps:

1. Engage both BC Hydro and Fortis Electric to develop an area specific plan outlining targets and potential activities to help encourage Energy Efficiency in Area D and Kaslo. Including the establishment of a regional community energy manager.
2. Village of Kaslo should identify partners and models to develop the micro Hydro projects on the reservoir and PRV system.
3. Develop a working group that would be responsible for developing the solar garden project at either Jewett School or Meadow Creek Hall.
4. Continue to support Hamill Creek Timber to identify and implement a potential biomass CHP by being a resource and conduit to information.
5. Area D and Kaslo may want to consider an incentive for the installation of renewable energy equipment.

Acronyms

ASHP	Air Source Heat Pump
BC	British Columbia
CEA	Community Energy Association
CEEI	Community Energy and Emissions Inventory
CEEP	Community Energy and Emissions Plan
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
EPA	Electricity Purchase Agreement
GHG	greenhouse gas
GHX	Ground Heat Exchanger / geoexchange system / Ground Source Heat Pump
GJ	Gigajoules
HCT	Hamill Creek Timber
IPP	Independent Power Producer
IUP	Investigative Use Permit
kW	kilowatt [10^3 watts]
kWh	kilowatt hour
LFG	landfill gas
MSW	municipal solid waste
mW	milliwatt [10^{-3} watts]
MW	megawatt [10^6 watts]
ODT	Oven Dry Tonne
PTAC	Packaged Terminal Air Conditioner
PV	Solar photovoltaics
RDCK	Regional District Central Kootenay
RTU	Rooftop Unit
SCEEP	Strategic Community Energy and Emissions Plan (see CEEP)

1. Introduction & Scope of Work

This document summarizes the findings of a high level review of potential renewable energy options by the Community Energy Association (CEA) in RDCK Area D and Kaslo. It is intended to provide a basic screening of renewable energy options and identify technologies and specific opportunities that warrant further study.

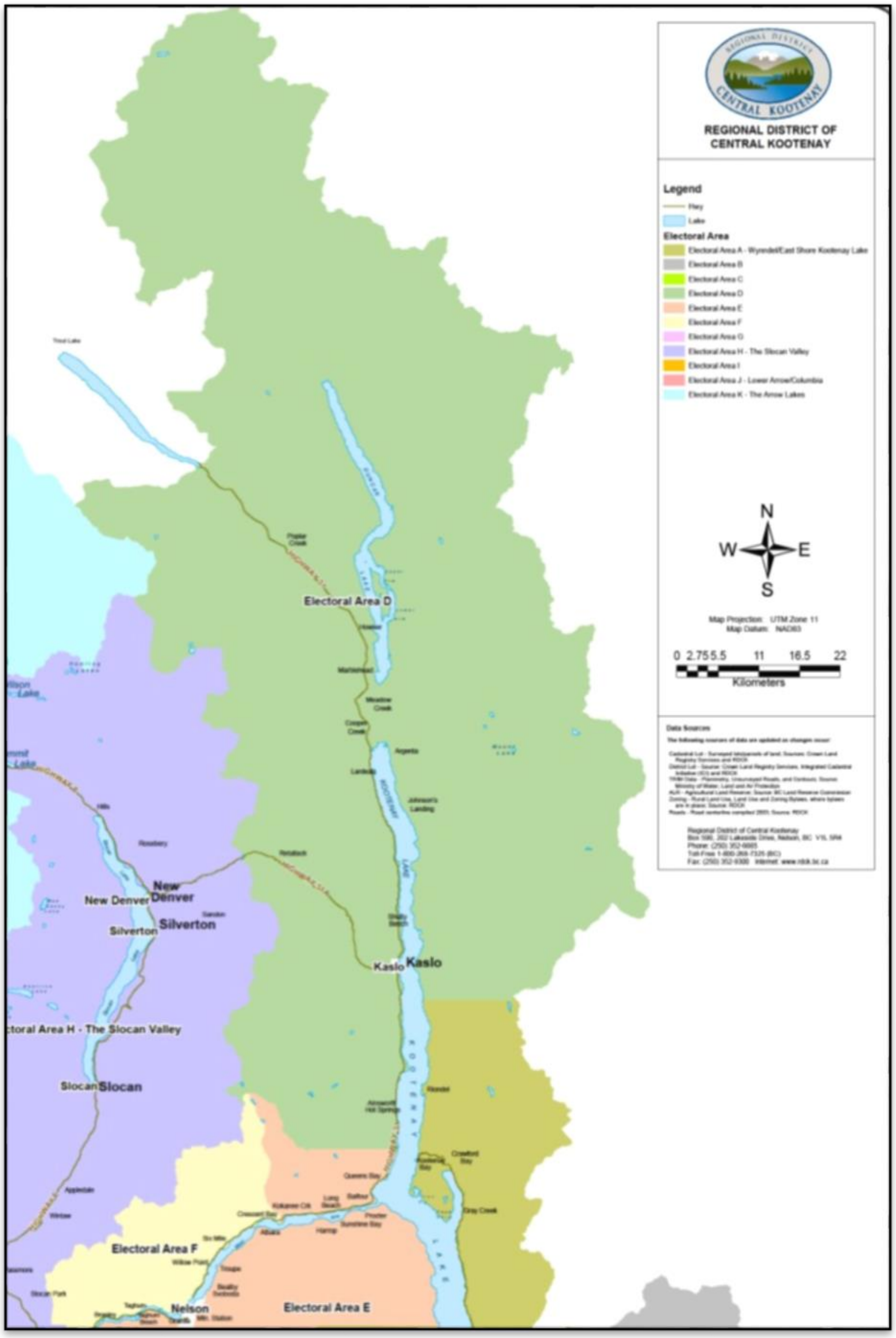


Figure 1 RDCK Area D Map

We will include several projects already short listed in the area.

1. Biomass in conjunction with the regional/basin wide initiatives looking at commercial CHP and residential heating with pellets
2. Micro Hydro on the Kaslo water system at either the reservoir inlet or inline at the PRV station downstream of the water treatment plant
3. Solar farm in the Lardeau Valley (2 locations)
4. Solar farm at the Kaslo Airport
5. Direct supports for individual households to do their own renewable energy initiatives

The five project potentials identified above represent projects that are readily achievable and appropriate in scale. Generally speaking the technologies being considered are relatively mature and appropriate for deployment in a rural setting.

This report relies heavily on local professional knowledge of a variety of Renewable Energy Projects and Technology. CEA would like to thank these people for sharing their time and information to develop this report. This includes:

1) Bob Watters – Solar Consultant
2) Cheryl Sinclair – Backwoods Solar
3) Don Scarlet – Micro Hydro Equipment Supplier and Operator
4) Ray Valentine – Solar and Micro Hydro Equipment Installer and operator
5) Dan Giessler – Nelson Hydro
6) Braden East – Electrician and Renewable Energy Installer

2. Background

2.1. *RDCK Area 'D' and Kaslo Energy & Emissions Expenditures*

Data for the energy & emissions from communities can be found in the Province's Community Energy & Emissions Inventories (CEEI). This data can be found for Kaslo and the RDCK Unincorporated areas (all of them taken together), but not individually.

Area D is different to some of the other RDCK Electoral Areas in that they do not have access to natural gas, which is less expensive than propane or heating oil. It is highly likely that the typical per capita energy consumption & emissions profile for Kaslo is more similar to the typical per capita energy consumption & emissions profile for Area D than data from other sources.

Although this data can be represented in terms of energy consumption and emissions, most communities are more interested in dollars (local jobs and economic development) and energy independence.

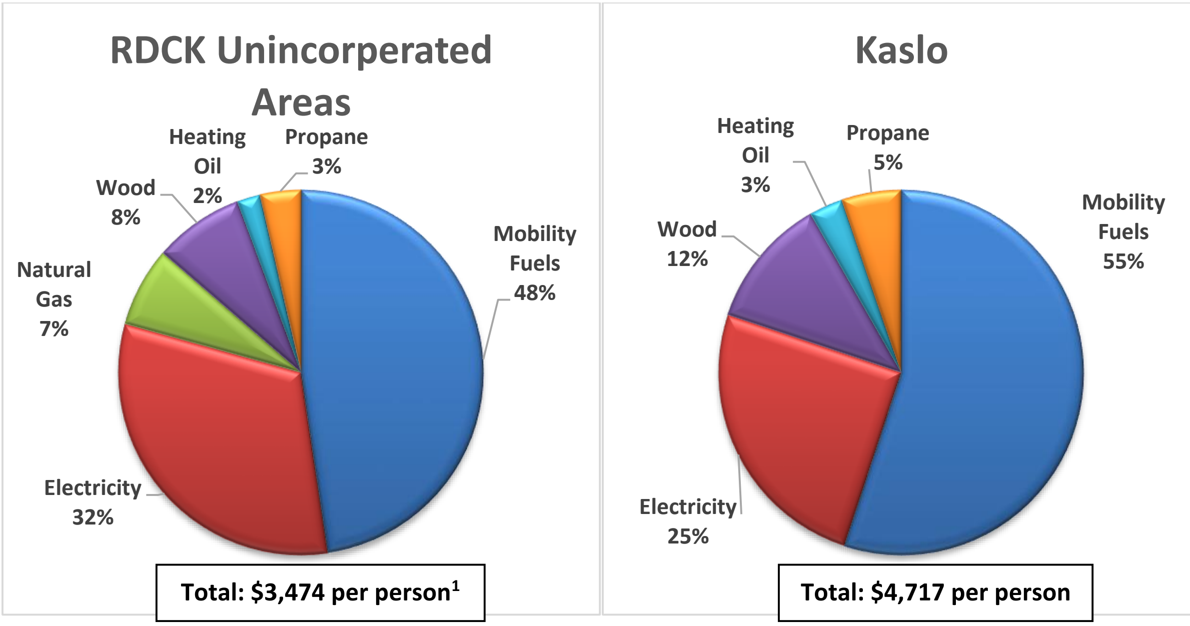


Figure 2 Estimated Breakdown of Energy Consumption for RDCK Unincorporated Areas[1] & Kaslo (source: CEEI for 2010 energy data, & research for 2016 SCEEP's)

Table 1 Estimated per capita & community energy expenditure for all of the communities in the study (source: CEEI for 2007 energy & population data, & research for 2012 local energy costing information*)

		Kaslo	Electorial Area D**	Total
	Population, est.	1,184	2,030	3,214
Per capita energy expenditure	Mobility fuels	$3,041	$3,041	
	Electricity	$1,081	$1,081	
	Heating oil	$169	$169	
	Propane	$253	$253	
	Total	$4,544	$4,544	
Community energy expenditure	Mobility fuels	$3,600,000	$6,170,000	$9,770,000
	Electricity	$1,280,000	$2,190,000	$3,470,000
	Heating oil	$200,000	$340,000	$540,000
	Propane	$300,000	$510,000	$810,000
	Total	$5,380,000	$8,800,000	$14,180,000

* Figures in table are rounded to three significant figures. There may be rounding errors.

** Because CEEI data is not available for Electoral Areas it has been assumed that their per capita energy costs are approximately the same as Kaslo.

Sources of inaccuracy in the CEEI data are described in Appendix 1. One of the most significant sources of error is propane consumption. The CEEI data should be taken as a useful guide and not be assumed to

[1] Based on all unincorporated areas in RDCK

be 100% accurate. It shows approximately how much money on a per capita or community basis is being exported each year. It also shows how much of that money can be attributed to each form of energy. This money leaves the communities. Reducing the outflows of money, and generating more energy within the communities, may therefore be of significant economic benefit.

2.2. *Energy Efficiency*

This study is focussed on renewable energy opportunities and how they relate to economic development, but the data above also makes the case for energy efficiency. Energy efficiency tends to have a quicker payback. CEA usually recommends energy efficiency opportunities be pursued prior to renewable energy opportunities. Figure 3 outlines this concept.

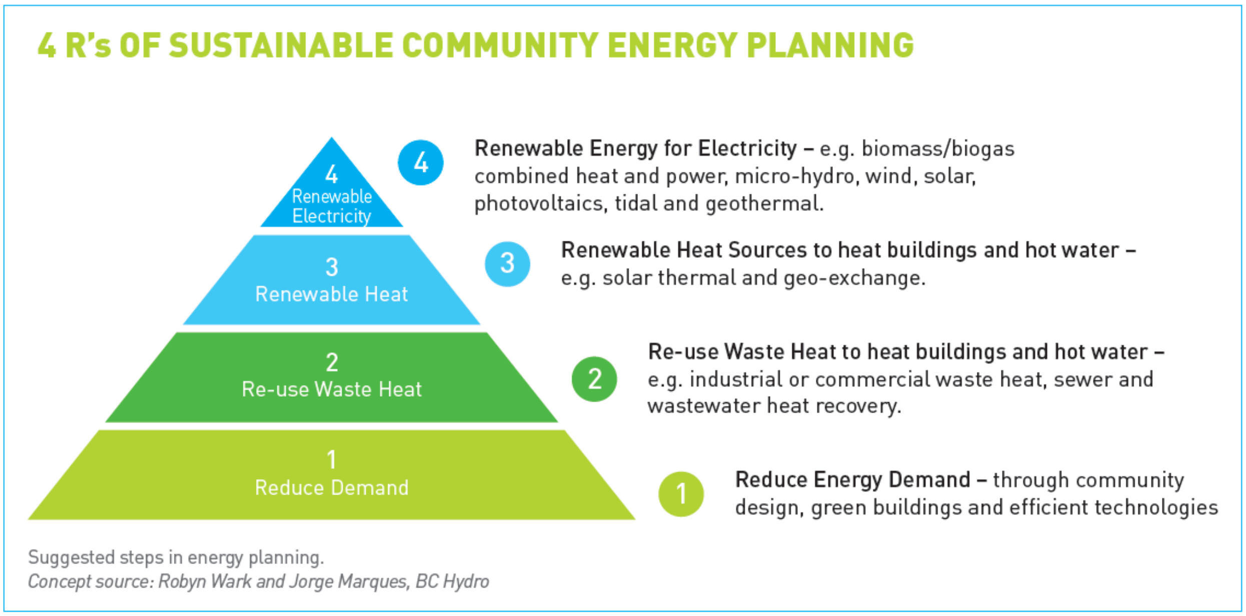


Figure 3 Sustainable Community Energy Planning

A similar hierarchy can be applied to the transportation sector. In the transportation sector, the easiest step to take is to reduce vehicular trip distances through appropriate urban form (planning) and transportation demand management.

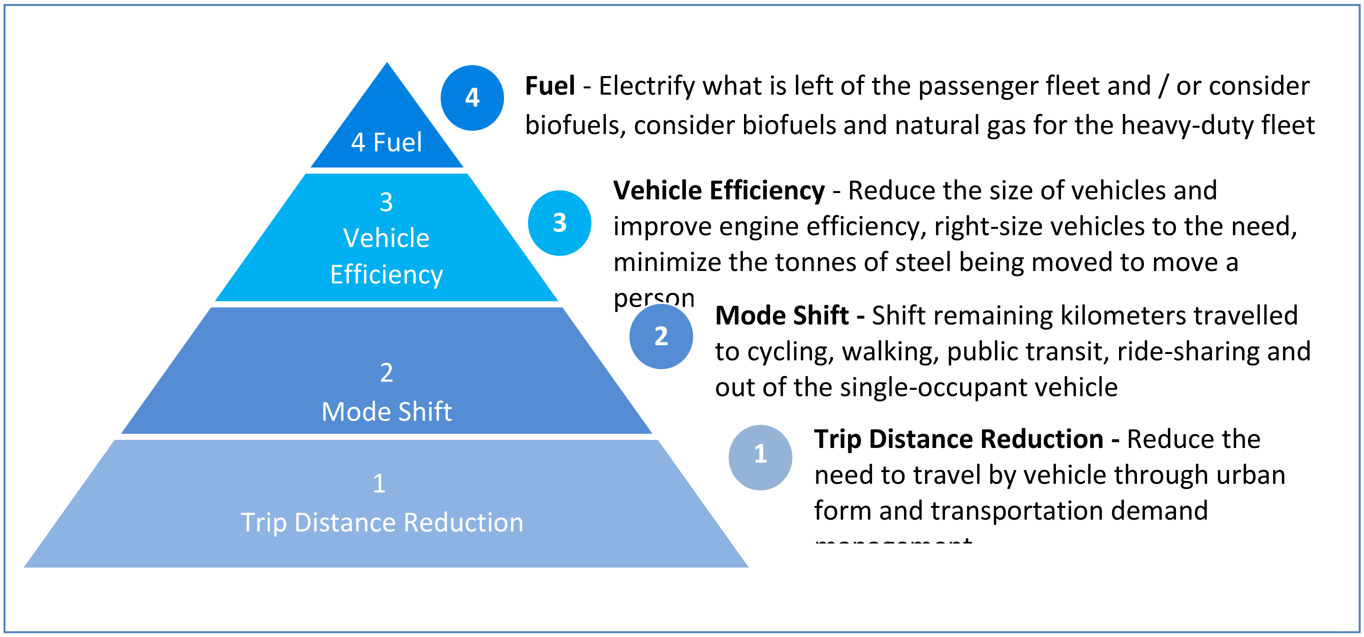


Figure 4 Sustainable Transportation Planning

2.3. *Comparison of Different Fuel Types*

Different forms of energy are purchased in different units. Electricity is sold by kWh, mobility fuels, heating oil, and propane are sold by litres. These forms of energy are converted to units of energy, such as Gigajoules (GJ), in order to be able to compare them like for like on a cost per unit of energy basis. This method can also be used in order to compare their carbon intensity per unit of energy.

From the cost / GJ chart, it should also be noted that energy prices vary according to application. The energy prices shown are typical for residential or small commercial. In many cases a large commercial, institutional, or industrial purchaser would be able to obtain lower prices than those shown.

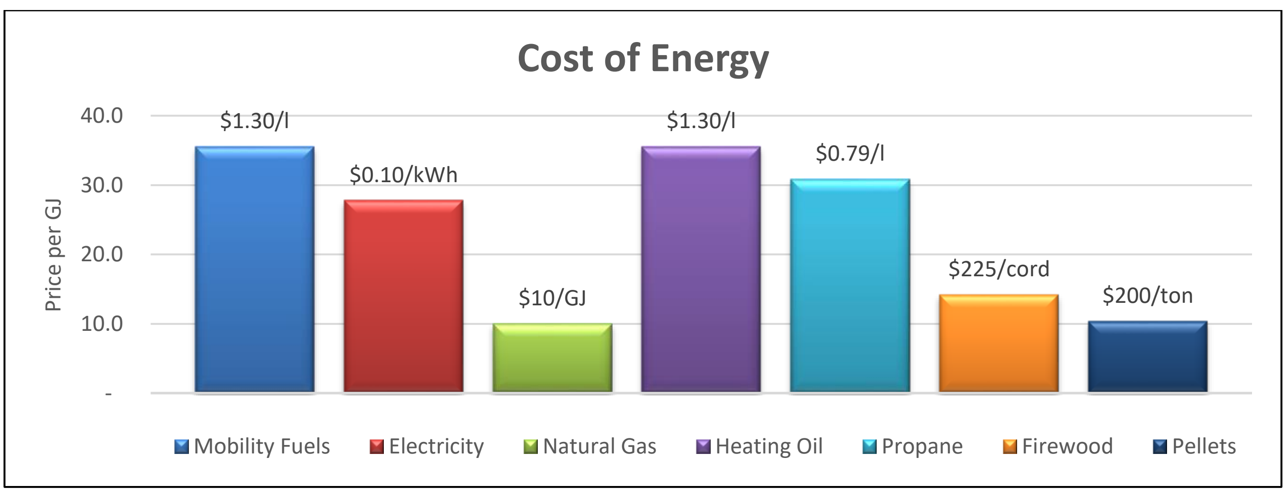


Figure 5 Comparison of costs of different forms of energy, on a dollar per GJ basis (source: research conducted for Kaslo SCEEP)

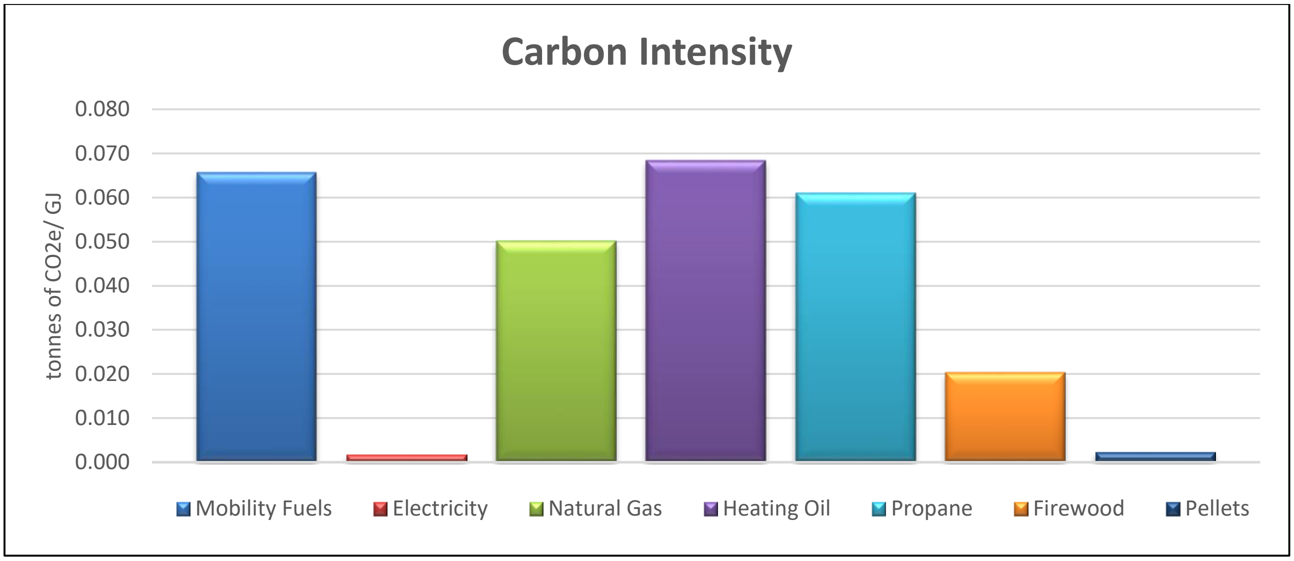


Figure 6 Comparison of carbon intensity of different forms of energy, on a tonnes of CO_2 per GJ basis (source: Smart Tool for Carbon Neutral Government, FortisBC Gas, Environment Canada – Canada's GHG Emissions Inventory)

Natural gas is not available in the study area, but is shown in the charts for comparison. From a renewable energy perspective, several important observations can be made about Figure 5 and 6

1. Buildings heated by propane or heating oil may provide particularly attractive opportunities for energy efficiency and renewable energy because of the relatively high costs of these fuels.
2. Wood pellets can be a significant renewable energy opportunity because they are a less costly form of energy, as well as having a low carbon intensity according to the Province of BC.
3. Although electricity is as expensive as many of the other forms of energy, a heat pump (either an air source heat pump or a ground source heat pump – also sometimes called a geoexchange or a geothermal system) typically uses 1/2 to 1/3 the energy of a baseboard heater to provide the same amount of heat. This reduces the cost of heat from a heat pump to approximately $9-12 per GJ.

Shifting buildings away from using heating oil, propane, and electric resistance heat (e.g. baseboards) towards using woodchip, wood pellets, air source heat pumps, and geoexchange systems can result in significant GHG reductions community wide, local economic development and significant energy cost savings across the community.

2.4. *Electricity Sales*

Area D is serviced by both BC Hydro and Fortis Electric. Each utility has different programs for the purchase of electricity. The current BC Hydro net metering program is designed for any residential or commercial BC Hydro customer and is the easiest option for someone to sell power to the grid, but is limited to 100 kW. The standing offer program (SOP) is open to anyone. The micro standing offer program (MSOP) is targeted towards First Nations and Communities and must therefore have at least 50% community ownership (municipality, not-for-profit, public sector or Agricultural sector) of the project. The MSOP is designed to be more streamlined than the traditional SOP and have a simpler Power Purchase Agreement.

Figure 7 Fortis Service Territory (Shaded Area)

Fortis Electric also has a net metering program but it is limited to 50 kW and is designed primarily for customers to generate their own electricity but not sales back to the grid. Fortis currently has an application before the BC Utilities Commission that would limit the system size for any net metering system to the approximate size needed to meet the customers needs with no (or limited) excess capacity. This differs from BC Hydro which does not have the same limitation. BC Hydro also pays a premium for any net electricity sent back to the grid where as Fortis would limit it to the rate they purchase electricity from BC Hydro. It is worth noting that both Fortis and BC Hydro net metering programs are not long term agreements and could change based on application to the BC Utilities Commission for changes, unlike a typical Electricity Purchase Agreement under SOP or MSOP. The potential of changes to the net metering rates and formulas represents a potential risk for any project that is developed.

Table 2 Summary of Electricity Purchase Options

Utility	Program	System Size Range	Pricing
BC Hydro	Net Metering	Up to 100 kW	$99.9/MWh
	Standing Offer Program	100 kW – 15 MW	$106.9/MWh
	Micro Standing Offer Program for Communities	100 kW – 1 MW	$106.5/MWh
Fortis	Net Metering	Up to 50 kW	$44.75/MWh

Any project that sells electricity to the grid will require some level of interconnection analysis. This report assumes that any interconnection will be relatively simple and have little or no cost. This may not be the case and any further project development will need to address this.

There are six communities that own their electric distribution grid. Nelson is the only one that currently generates and distributes their own electricity. In the 1960's most local governments chose to sell their electric distribution grids because of the cost and complexity of operating them[2].

3. Renewable Energy Screening

An overview of the applicability of green energy technologies for the study area based on the statement of work is on the following pages. Any reference to capital costs or revenues are included as reference only and should be considered as order of magnitude estimates.

3.1. *Biomass*

The use of biomass for energy is an age old practise and is still one of the largest sources of energy on a global scale. For the purposes of this report, biomass refers to woody debris sourced from the forest industry. The debris is available from a variety of sources all along the wood fibre supply chain from harvesting, milling to construction waste. Just as the source varies, so does the form of the residue including tops and limbs left over from harvesting, coarse sawmilling residues (often called hog fuel), wood chips, sawdust and shavings. We will refer to all of these materials simply as biomass unless otherwise stated.

[2]For more information please see the Utilities and Financing Guide available on our website: http://communityenergy.bc.ca/?dlm_download_category=renewable-energy-guide

In North America, biomass energy is normally done on either an industrial scale (pulp mill or sawmill) or on a residential scale (typically in the form of log wood used in a stove), fireplace, furnace or boiler. In the past 20-30 years there has been an evolution in Europe to the use of biomass in smaller more commercial heating applications (100 kW – 5MW). This trend is starting to take hold in Canada with BC being one of the leaders. In rural BC, the wood can be obtained at a low cost – see the charts in section 2.3. The technology in this sector is proven and commercially available. The use of biomass to produce both heat and power on the commercial scale is relatively new with fewer installations in Europe (approx. 500) then heat only.

The other significant biomass fuel is wood pellets. Pellets are produced by compressing fine wood particles into small regular cylinders. Wood pellets are usually more expensive than woodchips, however wood pellets do have some other advantages:

1) Pellets are better suited for smaller bioenergy installations (e.g. domestic, or other small buildings). They have a greater energy density by volume.
2) They are more uniform and have less moisture which means they combust easier, cleaner with less residues.
3) The storage of wood pellets is less bulky than the storage of woodchips – useful where space may be limited.
4) They can also be used in automatic system feed systems.
5) Pellets can be transported greater distances, so are less vulnerable to fluctuations in local fibre availability.

The use of pellets in residential commercial, and industrial applications is growing particularly in Europe. BC produces about 2 million tonnes of pellets per year with the vast majority be sent oversees.

Figure 8 Wood Pellets, Chips and Hog Fuel

Generally speaking all forms of biomass used in BC come from sustainable sources and are a by-product of traditional forest operations. Therefore in BC, biomass is considered to have little or no GHG emissions. Appendix 2 shows the results of a fibre availability analysis completed previously[3]. Concerns over the impact to air quality are covered in Appendix 3.

3.1.1. Biomass Combined Heat and Power

Commercial scale biomass CHP is a newer technology in the scale considered for the study area (50-500 kW). There have been several hundreds of systems installed in Europe. There are a number of projects in development in Canada but only one has been installed to date. Electricity only from biomass has not been considered as these systems are only economically feasible at scales significantly outside the scope of this analysis (15+ MW).

Appendix 4 contains a list of potential biomass CHP systems that may be appropriate for deployment in the study area. FP Innovations (a private forest research group) along with the National Research Council and CEA are looking to develop a pilot project that would be installed at UBC and operated for a 1-3 years in order to develop best practises in regards to sourcing and operating such systems.
Other examples of chip heat only systems in BC include:

1) A woodchip fuelled district energy system installed in the Village of Enderby heats 11 buildings including: an Inn, Interior Health building, open air municipal swimming pool, as well as commercial and industrial buildings. It consumes approx. 800 tonnes/yr, biomass from clean construction & demolition waste wood, sawmills, and value added wood products. Retail cost of the entire system was approximately $1 Million, with an estimated return on investment in 10+ years. It provides heat for slightly less than the price of natural gas.
2) The Village of Granisle has installed a small wood chip heating system to heat their 2000 ft^2 firehall. This system has been the catalyst for looking to expand biomass heating system to additional buildings. A detailed case study of this project is available at the following link www.ruralbcgreenenergy.com/project-case-studies/33-village-of-granisle

Looking at the study area there were two sawmills identified as good locations for biomass CHP. Hamill Creek Timber (HCT) and Boards by George. Previous research indicates there is more than enough biomass to supply a local biomass fueled CHP system. For further detail, see Appendix 2. A biomass CHP system would be most effective if the heat could be utilised onsite. Apart from HCT there are no

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[3] "Bioenergy Feasibility Analysis for Area D of RDCK" by Reg Renner, John Cathro and Bruce Blackwell, 2010

significant heat loads in the Meadow Creek area at this time. A biomass CHP system could be co-located at HCT where heat and power could be produced and consumed. Most likely the system would be operated 'behind the meter' with any excess electricity sold to BC Hydro using their net metering program. This may limit potential ownership models for the system. The most likely and simplest scenario would see HCT own and operate the CHP system. Alternately the system could be owned by a different entity and leased or rented to HCT to operate. HCT would make payments based on electricity sales and usage. The entity could be some form of partnership, either private or public, with HCT and a variety of others stakeholders (Co-op, limited partnership, etc.). HCT would also be the main fuel supplier. See Appendix 5 for resources that can be used to determine the structure of a potential utility business.

The capital cost of a project such as this one would $250-700,000 depending on size. Revenue would be derived from electricity and heat sales to the grid and HCT Timber, depending on the ownership model. If the system is owned by HCT Timber then the heat and electricity would be used to displace propane and depending on size result in electricity sales to the grid. The CHP system would allow HCT to be more diversified business resulting in a stronger more sustainable business. This in turns supports the economic stability of the Meadow Creek Area.

3.1.2. Biomass Heating with Wood Pellets

BC is a major global manufacturer and exporter of wood pellets. Use of wood pellets is distributed throughout the Province, but the continued use of more expensive heating options (such as heating oil, propane, and electric resistance heat such as baseboards) is evidence of large number of opportunities still available.

Domestic wood pellet stoves are common in rural BC due to the low cost of heating, ease of use, and relatively low capital cost. Examples of non-residential propane to wood pellet conversions in BC, that see considerable cost savings:

1) Baldy Hughes Addiction Treatment Centre and Therapeutic Community district heating system (a community of approximately 80 people near Prince George)
2) Lillooet Recreation Centre
3) Nazko Elementary School (Quesnel)
4) Alexis Creek & Tatla Elementary Schools (west of Williams Lake)
5) Burns Lake Arena is another example but the conversion of the building to a hydronic heating system was capital intensive given the shift from natural gas.

As demonstrated by the charts in section 2.3, wood pellets are a significant opportunity in the study area. There is an economic argument for encouraging domestic wood pellet stoves over heating by propane, heating oil, and electric resistance heat (e.g. baseboards). Local businesses could provide a fully automated service, and refill pellet bins/silos for a fee. New pellet heating equipment will also result in better air quality as compared to existing wood stoves. It is recommended that older more inefficient equipment which does not burn cleanly, be replaced as part of the RDCK wood stove exchange program. Caution should be used when replacing wood stoves with pellet equipment as it is possible that small businesses that provide firewood may be displaced resulting in negative economic impacts.

3.2. *Micro Hydro*

Electricity can be derived from flowing water in a number of ways. Most people are familiar with large scale dams and smaller scale run-of-river projects and there are many examples across the Kootenays. Electric energy is created by converting the potential energy of moving water over a change in elevation. Water at high pressure is used to spin a turbine or wheel. This in turn spins a generator to produce electricity.

Generating hydro electricity is a mature technology, that has been deployed in both on and off grid applications. Most projects require access to a water course. There is however a number of communities in BC that have significant elevation changes in their communities and are installing Hydro electric systems on their own domestic water supply.

The Village of Kaslo domestic water system is fed from Kemp Creek which accumulates a great deal of potential energy. Two locations are being considered where some of the potential energy can be converted to electricity for sale into the grid. The first is where water enters the water treatment plant and the second is at the main PRV station. Both represent excellent opportunities to generate electricity.

A detailed case study of a larger project undertaken by the District of Lake Country is available here www.ruralbcgreenenergy.com/project-case-studies/3-district-of-lake-country-micro-hydro-power-plant. Other examples and similar projects.

1) Argenta has a small hydro system owned by a cooperative and locally operated.
2) Nakusp has a 50 kW system incorporated into their drinking water systems at their reservoir.
3) City of Nelson is also actively looking at systems for their water supply.

3.2.1. Kaslo Water Reservoir

Research done previously[4] has estimated the potential to install a small micro Hydro system similar to the one installed in Nakusp. The system would be installed at the inlet to the plant as the water enters the break tank. The break tank is open to atmosphere so the maximum of energy is converted to electricity.

Figure 9 Nakusp Micro Hydro System

The size of this system is estimated at between 15-20 kW. It would generate approx. 149 MWh of electricity. The capital cost of this type of system would be $20-30,000. This estimate does not include the cost of connecting to the Fortis Electric System. Currently there is little or no demand at the reservoir and no electrical infrastructure. The cost of running a connection to the grid could be significant. The cost of this connection was outside of this study. If ALL of the electricity could be sold to Fortis Electric at the proposed net metering rate the Village would see revenues of approximately $6,500 a year.

If the production at this site exceeds the demand then other high energy consumption activities could be relocated to the site if possible in order to maximise the benefits of installing the system at this location.

The most likely scenario would see this system owned by the Village of Kaslo. Alternately, there may be the opportunity to partner with other public or private entities that could assist in the development of

[4] Don Scarlett - Personal Communication

the project and help to de-risk it’s operation. Nelson Hydro has expressed interest in working with communities looking to develop renewable energy systems.

3.2.2. Kaslo Pressure Reducing System

An inline Hydro system could be installed to provide the required pressure reduction within the water main domestic water supply line. This would replace but run in parallel to the existing system. The system would be slightly smaller than the system at the resivoir.in the 12-15 kW size. The system would be required to be closed atmosphere and maintain the minimum pressure needed to get to the treatment plant. The system would need to be designed to run in parallel with the PRV such that if the hydro system is shut down or fails water would be automatically diverted to the PRV.

Figure 10 Inline Hydro Generator from Soar Hydro Power

It is estimated that the system would cost approximately $50-60,000 and generate similar amounts of electricity and revenue as the system at the reservoir . The local (behind the meter) demand is low at this location which would have a significant impact on the economic viability based on net metering offered by Fortis Electric.

3.2.3. Kaslo Aggregated Hydro

These two micro hydro projects are very similar in scale and scope. Village of Kaslo Administration have expressed concerns about the Village being able to operate and maintain other renewable energy systems as well as the availability of local support. This is based on past experiences. Combining these two micro hydro projects together and developing a partnership to potentially own, operate, and maintain may help address some of these concerns. Possible local partners could include Nelson Hydro, who have expressed interest in community scale energy projects, or other qualified local interests.

3.3. *Solar Power*

There are currently many solar installation in the study area. Backwoods Solar, a local company, has installed approx. 130 kW of on-grid solar PV systems as well as 75 kW off-grid systems since 2010. In general, most of the Lardeau Valley has substantial solar potential. The technology is mature but also changing and improving rapidly. The price of solar PV panels has dropped significantly in the past number of years. The approximate cost of solar panels not including installation is $1000/kW[5].

The demand in solar energy continues to grow and a number of communities in the Kootenays have developed successful solar installations. The largest is the Sun Mine located in Kimberley BC. The 1.05 MW system has been in operation since June of 2015. It has 4032 panels mounted on 96 trackers to follow the sun and maximise the energy captured. The electricity is sold to BC Hydro. The capital cost was estimated at $5.3 million with the City of Kimberley contributing approximately $2 million and the remaining coming from a variety of sources including TECK, Columbia Basin Trust, Southern Interior Development Initiative Trust, and EcoSmart. Details are available at www.sunmine.ca

Figure 11 Kimberley Sun Mine

[5] Cheryl Sinclair, Backwoods Solar and Bob Watters, energy consultant – Personal Communication

The City of Nelson has developed a unique cooperative solar project. The Solar Garden Project has just finished construction with connection to the grid expected in Spring of 2017. Members of the cooperative purchase a portion of the solar generating equipment. In turn they are credited on their bill for any electricity generated by the system. The array is 60 kW which is 10 kW larger than originally proposed as there was significant demand. Energy will be valued at the current market rate. More information is available at http://www.nelson.ca/EN/main/services/electrical-services/energy-grants/solar-garden.html

Figure 12 Nelson Solar Garden

Two potential project sites for solar were identified within the study area. One is Meadow Creek at either the Jewett School or Meadow Creek Hall and the other is at the Kaslo Aerodrome. Fundamentally both locations have good potential for the collection of solar energy. According to the Natural Resources Canada solar Database Kimberley and Nelson have a solar potential[6] of 1205 kWh/kWp and 1116 kWh/kWp respectively. Meadow Creek and Kaslo have solar potential of 1140 kWh/kWp and 1134 kWh/kWp respectively. So based on this rating Meadow Creek and Kaslo solar arrays could be expected to produce marginally more electricity (about 2%) than the Nelson Solar Garden (all other factors being equal).

The biggest challenge for a local solar project is not technical but in developing the business plan and partnerships in order to develop an economically sustainable project based on current electricity

[6] Solar potential is the ratio how much electricity can be generated (kWh) in a year per kWp or peak rating of your solar panel. Therefore Meadow Creek with a solar potential 1140 kWh/kWp would expect to generate 1140 kWh per year of electricity for every one kW of solar panels.

purchase options (see section 2.4 electricity sales). The Nelson Solar Garden is successful because they are able to buy and use the electricity themselves because Nelson has their own utility.

3.3.1. Lardeau Valley Solar Farm

Jewett School and Meadow Creek Hall were identified as a potential sites for a solar farm. Both have ample space and are situated in the BC Hydro service area which qualify it for a net metering rate of $0.0999/kWh. A high level analysis and proposal was completed in 2013[7]. At that time it was estimated that a 20 kW array would generate approximately 37 MWh of electricity. A RETScreen analysis[8] for the same location using similar panels resulted in an approximately 29 MWh. These estimates differ by 25% but are within the error range for this report. The estimated cost for the equipment for this installation would be $20,000. This estimate does not include the installation costs.

The most likely scenario would see the project developed as a community project with community ownership. This aligns with trying to reduce the operating costs of either facility, as they offer are currently offering significant benefits to the local area. This could be a not-for profit society already in existence or a special purpose vehicle. Given this scenario it is likely, local expertise could be used to install the system using locally available resources (people and products). This would improve the viability of the project. Assuming $10,000 for installation the total cost of the project would be $30,000 or $1500/kW [9] [10].

The system could be expected to generate approximately $3500/year in revenue (after connection fees) assuming all of the electricity is sold on to the grid. This equates to an 8 or 9 year simple payback. In reality, some, if not all, of the electricity produced would be used reduce the electricity bought for

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[7] Robert Watters –Personal Communication

[8] RETScreen is a software tool developed by the Government of Canada to evaluate renewable energy projects. The simulation was based on the Meadow Creek location and assuming a fixed panel with 17% panel efficiency and 50% slope.

[9] This is significantly different then the City of Nelson which installed a utility grade system with significant expert input in the purchase, design and construction. The estimated capital for the original 50 kW array was $225,000 or $4500/kW. Source - http://thenelsondaily.com/news/solar-garden-done-deal-nelson-hydro-manager-declares-40061#.WDKMDvkrJPY accessed Nov. 20, 2016

[10] The final project cost will likely be closer to $300,000 but with a total of 60 kW of installed capacity or $5000/kW – Personal Communication with Nelson Hydro Staff

Jewett School or Meadow Creek Hall. The net result is that both systems could be expected to reduce the operating costs of either facility but most likely not be a significant source of revenue.

3.3.2. Kaslo Aerodrome

The aerodrome site has a similar potential for the generation of solar electricity as the Meadow Creek site. Currently there is little activity at the site and has limited demand for electricity. It is serviced by the existing grid. This site is in the Fortis Electric territory and is subject to their metering program. As was mentioned earlier the Fortis electric net metering program was designed to displace grid electricity with self generated electricity and not electricity sales (as compared to BC Hydro). The most likely opportunity for electricity sales would come from the SOP program that has a minimum size of 100 kW. In addition, the program would require the proponent to sign a Electricity Purchase Agreement that typically includes provisions for performance and interconnection standards. The result is that the installation would need to be significantly more robust than Meadow Creek. It is estimated the installed cost per kW would be similar to the Nelson Hydro installation for fixed panels of $4500/kW or the $5000/kW for the tracking panels at the Kimberly Sun Mine.

The model for both the Nelson Solar Garden and the SunMine relied heavily on grants in order to prove to make the projects successful. Without grants the SunMine would have an approximately 25 year payback[11]. The Nelson Solar Garden is estimated to be 15-20 years[12].

Given that there is:

1) limited demand for energy at the Aerodrome,
2) limited benefits derived from the Aerodrome for the community,
3) Potentially modest economic reward, and
4) a significant investment of people and financial resources to develop a successful project;

no further analysis was completed. If a wholesale redevelopment of the site was to be considered, the potential for this project should be revaluated.

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[11] Analysis based on a $216,000/year break even figure and $5.3 million capital cost. Source http://www.sunmine.ca/news accessed Nov. 20, 2016

[12] Personal Communication – Nelson Solar Garden Investor

3.4. *Direct Supports for Residents*

Within the Local Government Act local governments have a variety of tools to impact and incent climate change.

3.4.1. Cash Rebates to Residents

The use of cash incentives is common to achieve community goals and accepted within the community charter. Examples of LG incentives in regards to renewable energy are;

1) Regional District of Nanaimo Renewable Energy Systems Incentives - The RDN will provide a $250 rebate on Solar hot water, Photovoltaic, Geoexchange (ground or water source), micro (1 kW) and small wind (1-10 kW) systems. The rebate is $250. Residents must submit an invoice from a qualified contractor with photos and basic information (name, address, etc.). An additional $400 rebate is available should the project require a variance permit. Specific details are available at http://www.rdn.bc.ca/cms.asp?wpID=2434.
2) Oil to Heat Pump Incentives - The provincial government currently has a funding program to encourage people to switch from oil to air source heat pumps. The value of the incentive ranges from $800 to $1700. Four LG's (Capital Regional District, District of Saanich, Comox Valley Regional District Electoral Areas and City of Campbell Rvier) have chosen to add additional incentives ranging from $150 -$1000. More information is available at http://oiltoheatpump.ca/.
3) Energy Diets – A number of jurisdictions in the Kootenays have previously offered incentives related to energy. The program is no longer being offered but the RDCK and Nelson Hydro are currently working to develop a proposal to re-establish a similar program.

The value of the incentive should be based on the size of the capital pool as well as the number of systems that could be installed. It is further recommended that the incentive be limited systems installed by qualified installers to ensure the quality of project (as compared to some DIY). The best program have simple methods to apply and simple requirements. This will allow for simplicity of processing claims and the cost of the project. It is worth noting that any type of incentive will require staff time to administer and that should be factored into the program design.

The total value of the program would depend on available funding. Rebates in the range of 5-10% of the anticipated capital cost are common. The rebate can be based on a sliding scale (% of capital, energy generated etc.) but having a flat rate would be simplest to administer. The timing of the rebate program should be long enough for people to research and develop projects but still fit in with local government needs. For example offering a program with a pool of capital initially and then a top up at a later date, depending on uptake. This should be stated explicitly in the program to allow respondents and installers to plan accordingly. Given the remote nature of Kaslo and Area D it would be appropriate to develop a list of prequalified installers for residents to chose from. The RDCK already administers a Wood Stove Exchange program that could be used as a model for a renewable incentive program. CEA completed a review of a number of incentives programs and the report is available at the following link: http://communityenergy.bc.ca/?dlm_download_category=efficiency

3.4.2. Revitalization Tax Exemptions

Kaslo could choose to create a Revitalization Tax Exemptions (RVTE) for green building technologies such as solar panels, etc. The program allows municipal governments to exempt certain properties from taxes. The exemption could be tied to an area or property type as well as the value of the land or improvements. Area D residents would not be eligible for an RVTE program as regional districts do not qualify under the local government act. The specific details for setting up a RVTE are available at: http://www.cscd.gov.bc.ca/lgd/gov_structure/library/community_charter_revital_tax_exemptions.pdf. A number of local governments have set up RVTE for green buildings including City of Campbell River and Prince George. The programs have had limited success. They also tend to be administratively heavy.

3.4.3. Energy Efficiency – Leveraging Existing Utility Programs

As was noted in section 2.2 energy efficiency is the most economical way of addressing the value of local energy. There are currently a number of programs available from both BC Hydro and Fortis Electric that can be used to reduce energy costs in communities. These include:

- Insulation
- Space heating
- Water Heaters
- Ventilation
- Draft Proofing
- Air Source Heat Pumps
- Windows and Doors

Appendix 6 contains a matrix of available rebate programs.

An additional program of potentially significant note is the Energy Conservation Assistance program or ECAP. The program provides income qualified residential customers with a free home energy evaluation, as well as free installation of energy-saving products by a qualified contractor including:

- energy-saving light bulbs
- faucet aerators for the kitchen and bathroom
- water-efficient showerheads
- water heater pipe wrap
- exterior door weather-stripping
- free energy-efficiency advice to help you create a more comfortable home for your family

Some homes may also qualify for:

- an ENERGY STAR® certified refrigerator
- attic, wall and/or crawlspace insulation

The following table outlines the income thresholds:

Table 3 ECAP Income Thresholds

Household size	Maximum Income
1 person	$32,000
2 persons	$39,800
3 persons	$48,900
4 persons	$59,400
5 persons	$67,400
6 persons	$76,000
7 or more persons	$84,600

In many cases these programs are not being maximised for a variety of reasons. In recent years the use of "energy diets" in Rossland and the East Kootenay have been very successful. The programs were successful because they had a project champion or coordinator that was able to connect with local people, help them to understand programs that are available and help them access them. This could be done in Area D and Kaslo by organizing a variety of programs and sessions. This is often the role of a Community Energy Manager. Examples of specific programs would include:

1) Market available rebates and incentives, with support from Fortis and BC Hydro
2) Support people to access specific programs by
    - coordinating bulk buys of goods and services such as energy advisors to do pre- and post- retrofit evaluations or spray in insulation contractors
    - coordinating outside expertise/services to reduce travel costs – plumbers, HVAC, electricians, etc.
3) Facilitate workshops/activities with trained people that will empower local residents to complete their own efficiency upgrades. Examples could include:
    - Working with the local fire service to use their Infra Red Cameras to identify air leakage.
    - How to seal common sources of air leakage in your home.

- Identification of parasitic[13] electricity loads

4. Scan Results

4.1. *Overall Project Rankings*

The following table evaluates each of the projects based on Project Implementation, Economic Impact, Community Sustainability, and Local Government Role. The following table defines these characteristic and how they are ranked.

Table 4 Criteria Definitions and Rankings

Characteristic	Definition	Positive	Neutral	Negative
Project Implementation	How difficult is this project to implement for the community?	No partners or additional capital required and could be implemented in under a year	Requires either additional partners, capital and could be implemented in under a year	Requires additional partners and capital or longer than a year to implement
Economic Impact	What is the value of the anticipated financial rewards within the community (or members)?	Significant Revenue or savings in the area economy	Some savings or revenue in the area economy	Little saving or revenue in the area economy
Community Sustainability	How significantly will this improve the community within the local area?	Significantly	Moderately	Little
Role of Local Government	What level of input is required of the local government?	Lead	Partner	Advocate

The following table rates the projects based on the above criteria. The rating are based on CEA in knowledge and experience from working with communities on renewable energy as well as discussions with local residents.

[13] Parasitic loads refer to appliances that draw electricity even when not being used. This could include TV's, laptops, etc.

Table 5 Scan Results

Project	Implementation	Impact	Sustainability	Role for LG
Biomass Combined Heat and Power				
Biomass Heating with Pellets				
Kaslo Water Reservoir				
Kaslo Pressure Reducing System				
Kaslo Aggregated Hydro				
Lardeau Valley Solar Farm				
Kaslo Aerodrome				
Cash Rebates to Residents				
Energy Efficiency				
Revitalization Tax Exemptions				

Overall the table shows that actively supporting energy efficiency upgrades within the study area is an area where local government support can have the most impact in the near term.

Biomass CHP represents a good opportunity to support local business but given that the largest direct beneficiary will be HCT, local government should advocate for them and help them to implement a solution that works best for themselves. In the event that HCT is unable to develop the CHP system on their own there may be a need to update implementation to needing additional partners or capital.

The development of the aggregated hydro project is most likely to achieve a positive outcome, assuming the appropriate partners and business case can be developed.

The Lardeau Solar project represents a good opportunity to help stabilise either the Jewett School, in the event the community is required to take over it's operation. The installation of solar at the Meadow Creek Hall would help to reduce energy costs and ensure the continued viability of the facility. These projects are complimentary and could be completed either together or in a phased approach depending on funding and support from the community.

4.2. *Residential Project Rankings*

There are a variety of types of renewable energy that can be installed in Kaslo and Area D for residential usage. It is recommended that any incentive program to support residential energy deployment be broad based with some technologies prequalified and others that would need prior approval. The most likely prequalified are solar (Hot Water/PV), pellet or woodchip heating systems, micro hydro, air source heat pumps. This is based on discussions of local capacity within the region. There are opportunities for prequalified renewable energy systems others such as wind, and geothermal but based on discussions there is limited local capacity for these types of energy. Other technologies such as biogas, cord wood heating, etc. would need to be approved for the incentive prior to construction. In these cases the focus should be on professionally installed and certified systems to ensure a high quality return on investment.

Different types of renewable energy provide different types of benefits. For example installing a PV solar panel in a grid tied home may result in energy cost savings but, because BC electricity grid is very low carbon, it will have little impact toward reducing GHG's. The following table summarizes the most likely technologies and rates them as likely having a significant impact (green), moderate impact (yellow), or minimal impact (red). This rating is based on the existing conditions of the home where the installation and most common energy produced (heat or electricity). For example, an Air Source Heat Pump will be more efficient then electric baseboard heat, but it still has a relatively high electricity demand and therefore will not provide significant energy independence.

Table 6 Residential Renewable Energy Technologies

Technology	Residential Conditions	Revenue Generation	Energy Savings	GHG Savings	Energy Independence
Solar PV	Grid Tied – BC Hydro	yellow	green	red	green
	Grid Tied - Fortis	red	green	red	green
	Off Grid	red	green	green	green
Wind	Grid Tied – BC Hydro	yellow	green	red	green
	Grid Tied – Fortis	red	green	red	green
	Off Grid	red	green	green	green
Micro Hydro	Grid Tied – BC Hydro	yellow	green	red	green
	Grid Tied - Fortis	red	green	red	green
	Off Grid	red	green	green	green
Solar Thermal	Propane/Fuel Oil Hot Water	red	green	green	yellow
	Electric Hot Water	red	green	red	yellow
Pellet/Wood Chip Heating	Propane/Fuel Oil Heat	red	green	yellow	yellow
	Electric Heat	red	green	red	yellow
Air Source Heat Pumps	Propane/Fuel Oil Heat	red	green	yellow	red
	Electric Heat	red	green	red	red
Geothermal Heat	Propane/Fuel Oil Heat	red	green	yellow	red

	Electric Heat				

Generally speaking the generation of electricity is for energy savings and energy independence. The generation of revenue is limited by the capital cost and, in the case of Fortis, the limitation of the net metering program. GHG savings for most technologies are moderate. The main reason is that the electric grid in BC already has very low GHG's[14]. Some of the gains from switching from fossil fuels are offset by higher electricity usage (air source heat pumps or Geothermal). Wood Chips and Pellets have lower GHG emissions than fossil fuels but slightly higher than BC electricity. When it comes to energy independence most of the renewable heating technologies have a requirement for electricity ranging from moderate to substantial which limits there ability to contribute to energy independence.

5. Recommendations

The following are highly recommended as next steps:

1. Engage both BC Hydro and Fortis Electric to develop an area specific plan outlining targets and potential activities to help encourage Energy Efficiency in Area D and Kaslo. Including the establishment of a regional community energy manager.
2. Village of Kaslo should identify partners and models to develop the micro Hydro projects on the reservoir and PRV system.
3. Develop a working group that would be responsible for developing the solar garden project at either Jewett School or Meadow Creek Hall. This could include a cooperative model or under the existing operator mandates. Meadow Creek would be the initial priority as it will have impact immediately. Solar panels installed at Jewett School, while it is still operated by the school district would be expected to have marginal local benefits as any savings and potential earnings would most likely be accrued by the school district. In the event the Jewett School is transferred to the community ownership, this is no longer the case and both projects could be expected to have equal priority and benefits.

[14] The GHG intensity of electricity from BC Hydro and Fortis Electric at 10.67 and 2.59 tonnes of CO_2e/GWh respectively. Propane has a GHG intensity of 241.55 tonnes of CO_2e/GWh or 22 times the intensity of BC Hydro and 93 times that of Fortis Electric. This is based on factors from "2016/17 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions – including Guidance for Public Sector organizations, Local Governments and Community Emissions" guidebook.

4. Continue to support Hamill Creek Timber to identify and implement a potential biomass CHP by being a resource and conduit to information.
5. Area D and Kaslo may want to consider an incentive for the installation of renewable energy equipment based on section 4.2 of this report. The incentive program should be simple to access and administer. CEA has experience in developing these types of programs and can provide assistance.

APPENDICES

1. Sources of Inaccuracy in CEEI Data

The following are some of the potential sources of inaccuracy in the CEEI data:

- Due to privacy issues, the electricity consumption associated with large industry been withheld.
- Estimated energy consumption from heating oil and propane suffers from inaccuracies as it is difficult to track. The Province has contacted heating oil & propane suppliers from across BC, and tried to estimate consumption in communities.
- Estimated consumption of mobility fuels in communities is difficult to track. The Province has estimated mobility fuel consumption for communities by taking the number of vehicles that are registered for that community, and taking estimates for the Vehicle Kilometres Travelled (VKT) for the local area. There can be inaccuracies in both of these figures.

2. Supply & Demand of Biomass for Woodchip Systems

A 2010 report authored by Reg Renner, John Cathro and Bruce Blackwell investigated the amount of Biomass available in Area D. The report was commissioned by then Area D director Andy Shadrack. The report summarised a number of opportunities as well as estimated the volumes of biomass in the following table. These volumes would be available to support a bioenergy project. Based on conversations with HCT, they are still producing similar volumes of material. Boards by George has cut back production and is producing approx. 25% of this volume. These estimates are estimates only and should be confirmed as part of any future bioenergy project.

Table 7 Biomass Availability

Potential sources	Oven dry tonnes (odt's) per year, estimated
Hamill Creek Timber (Mill Residues)	1,800
Boards by George (Mill Residues)	2,000
Kaslo Community Forest (Harvest Residues)	2,900
Minimum estimated total	**6,700**

3. Bioenergy – Air Quality

Table 8 Comparing Bioenergy Air Emissions

Emissions	Domestic pellet stove	Domestic oil furnace
NOx	410 g/GJ	1,000 g/GJ
SO_2	11 g/GJ	28 g/GJ
Dust (PM_{10})	130 g/GJ	25 g/GJ

Source: derived from An Information Guide on Pursuing Biomass Energy Opportunities and Technologies in British Columbia, BC Bioenergy Network and Province of BC, by Envint Consulting, June 2010 (updated May 2011)

Table 9 Residential Bioenergy Heating System Emissions

Emissions	Residential – advanced wood combustion techniques, <1MW pellet stoves	Residential – advanced wood combustion techniques, <1MW advanced wood stoves	Residential – non-advanced wood stoves	Residential – small household <50kW_{th} boilers, liquid fuel (includes propane)
NOx	90 g/GJ	90 g/GJ	50 g/GJ	70 g/GJ
SOx	20 g/GJ	20 g/GJ	10 g/GJ	140 g/GJ
Dust (PM_{10})	76 g/GJ	240 g/GJ	810 g/GJ	3 g/GJ
Fine dust ($PM_{2.5}$)	76 g/GJ	240 g/GJ	810 g/GJ	3 g/GJ

Table 10 Commercial Biomass Heating System Emissions

Emissions	Commercial / institutional – advanced wood combustion techniques, <1MW automatic boilers	Commercial / institutional liquid fuels, inc. propane (Tier 1 data)
NOx	150 g/GJ	100 g/GJ
SOx	20 g/GJ	140 g/GJ
Dust (PM_{10})	66 g/GJ	21.5 g/GJ
Fine dust ($PM_{2.5}$)	66 g/GJ	16.5 g/GJ

Source: EMEP/EEA air pollutant emission inventory guidebook 2009 / Technical guidance to prepare national emission inventories, European Environment Agency, 2009

A variety of data sources are provided above, and where direct comparisons can be made between technologies there are some significant differences between the data sources, and there may be a variety of reasons to explain this (e.g. technology changes in time and by location, and difference in measurement or calculation methodology).

Concerns are mainly limited to the impact of particulates (dust), and this can be mitigated by simultaneously encouraging the upgrade of older residential wood stoves to newer clean burning ones. Older residential wood stoves produce much larger volumes of particulate emissions per unit of energy consumed than new residential wood stoves, and much more than new commercial bioenergy boilers.

4. Biomass CHP Systems

There are a number of CHP system suppliers currently on the market in Europe. The following list of suppliers maybe of interest should more information on biomass CHP is needed. Currently only the Spanner system (Germany) sold by Borealis Wood Power (Ontario) is the only small scale CHP installation in Canada. Spanner have close to 500 systems mainly in Germany. Community Power Corporation (CPC) is a California based company that produces the Biomass 100. Volter is a Finnish company with a number of installations and is looking to enter the Canadian market. All three of the systems are gasifiers couples with an internal combustion engine. The gasifier converts the biomass into a gas. The gas is then conditioned and combusted in an internal combustion engine. TrioGen ORC is a Dutch Organic Rankine Cycle system that uses an organic fluid instead of steam in a turbine to produce electricity. They have approximately 40 system installed primarily in the Netherlands.

Table 11 Biomass CHP System List

System	Size	Type	Website
Spanner	45 kWe	Gasifier	http://www.borealiswoodpower.com/
CPC	130 kWe	Gasifier	http://www.gocpc.com/
Volter	40 kWe	Gasifier	http://volter.fi/
TrioGen ORC	170 kWe	ORC	http://www.triogen.nl/

5. Thought Leadership

CEA is a recognized knowledge broker regarding local government's role in promoting and implementing renewable energy. CEA has authored a number of publications, which can be leveraged and are available on CEA's website at www.communityenergy.bc.ca under resources. The relevant publications for this project and where they would apply are shown in the table below.

Table 12 CEA Publications

Publication	Description
Small Scale Biomass District Heating Guide	The guide is designed to support the growing number of small communities interested in biomass district heating at a high level. The guide is written primarily for local government elected officials and staff to support in the development of clean energy and a green economy. The scale of district heating being considered in this guide is approximately 150kW to 3MW.
Small Scale Biomass District Heating Handbook	The handbook is designed to support a growing number of small communities across British Columbia and Alberta interested in making a business case for biomass district heating (DH). It is a companion piece to the "Small Scale Biomass District Heating Guide". This handbook provides a more detailed focus on considerations associated with each project element.
Investing in Green Energy Projects and Utilities – Vol. 1: Investment Guide	The guide introduces the reader to green energy systems (stages, integration and motivation) and provides detailed information to support decisions about ownership and operation, legal and financial aspects and public engagement.
Investing in Green Energy Projects and Utilities – Vol. 2: Case Studies	The guide has fundamental information captured for 38 green energy projects or utilities located throughout BC. Projects on the list were evaluated and a total of 13 projects and utilities were selected for detailed case studies.
Utilities and Financing Guide	Utilities and Financing provides an introduction to the ways in which local governments can promote and finance the use of renewable energy in their communities. The focus of this guide is to outline why local governments are considering becoming involved in the provision of energy services, briefly introduce the policy and legislative contexts that enable and limit local government action, outline opportunities for the use of renewable energy within corporate operations, describe how local governments can actively deliver renewable energy themselves through the formation of a local government utility or energy services company, and outline different business models of ownership, operation and financing renewable energy projects.
Heating for Communities	Heating Our Communities (HOC) is one module of the Community Energy Association's Renewable Energy Guide for Local Governments in British Columbia. HOC has been written for local government elected officials and staff interested in encouraging the use of renewable sources of energy for heating in communities. HOC aims to provide a sufficiently comprehensive survey of heating system considerations and fuel sources so local government staff and officials may be able to discuss their relevance to their particular community in an informed way.

6. Available Utility Rebates and Incentives

List of Rebates currently available from BC Hydro and Fortis

https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/residential/programs/HRRP-Rebates-Offer-Table.pdf

Home Renovation Rebate Offer
Rebates as of September 1, 2016

Rebates and eligibility may change at any time. For more details, application forms, eligible products and full terms and conditions, visit **bchydro.com/homerebates** or **fortisbc.com/homerebates.**

Individual upgrades		
Upgrade	**Rebate**	**Requirements**
Applications for all individual upgrades must be received within 6 months of the installation of an eligible upgrade		
Insulation[1] • Attic • Exterior wall cavities • Exterior wall sheathing • Basement/ crawlspace walls • Other – exposed floor, floor over crawlspace, basement header	Attic insulation $0.02 × R-value added × square feet Basement and exterior wall insulation $0.08 × R-value added × square feet Other insulation $0.05 × R-value added × square feet Example: $0.02 × R20 × 500 sq. ft. = $200	Applications will only be processed for combined insulation rebates of $50 or more. Location installed / Minimum R-value added / Maximum rebate: attic – flat and cathedral ceiling / R12 / $600 exterior wall cavities / R12 / $1,200 combined exterior wall sheathing / R3.8 / ($1,200 combined) basement/crawlspace walls / R10 / $1,000 other – exposed floor, floor over crawlspace, basement header / R20 / $450
Space heating (electric)[2] • Variable speed mini-split air source heat pump (ductless heat pump)[3]	$800	Find **eligible models.**
Space heating (gas)[4] • FortisBC eligible EnerChoice® fireplace	$300	Find **eligibility requirements and qualifying models.**
Water heaters (gas)[5] • ENERGY STAR® 0.67 storage tank	$200	See **fortisbc.com/waterheater** for qualifying models and program terms and conditions.
• non-condensing tankless	$400	
• condensing tankless and hybrid	$500	
• condensing storage tank	$1,000	
Ventilation • ENERGY STAR® bathroom fan	$25 per fan	Limited to two fans per Customer. Find **eligible models.**

Location installed	Minimum R-value added	Maximum rebate
attic – flat and cathedral ceiling	R12	$600
exterior wall cavities	R12	$1,200 combined
exterior wall sheathing	R3.8	
basement/crawlspace walls	R10	$1,000
other – exposed floor, floor over crawlspace, basement header	R20	$450

We're working together to help B.C. save energy.

BC Hydro Power smart | FORTIS BC Energy at work

Energy advisor supported upgrades

Upgrade	Rebate	Requirements
For all energy advisor supported upgrades: Complete both a pre- and post-upgrade EnerGuide home evaluation. Have your energy advisor submit the Energy Advisor Supported Upgrades Application in addition to your **Home Renovation Rebate Application.**		
Pre- and post-upgrade EnerGuide home evaluation This will include the following value-added services: • Expert 3rd party consultation • A customized, detailed Energy Efficiency Action Roadmap	$150 Energy Coach Home Evaluation Rebate[6]	• Complete both the pre- and post-upgrade EnerGuide* home evaluation after September 1, 2016. • Use a program-qualified energy advisor. Find your program-qualified energy advisor **here**.
Draftproofing	$10 × every 1% of air leakage reduction Example: $10 × 15 = $150	• Complete the post-upgrade EnerGuide home evaluation, and submit all required rebate application forms, within 36 months of the initial pre-upgrade EnerGuide evaluation. • Rebate is based on the difference between the pre- and post-upgrade EnerGuide home evaluation air leakage rate. • Applications will only be processed for draftproofing rebates of $50 or more. • Maximum rebate is $500.
Bonus Offer — Install three or more eligible upgrades (pre- and post-upgrade EnerGuide home evaluation required)		
Install three or more of the following: • Insulation – attic (flat and cathedral ceiling) • Insulation – exterior wall cavities • Insulation – exterior sheathing • Insulation – basement/crawlspace • Insulation – other • Draftproofing • ENERGY STAR or high-efficiency space heating system • **FortisBC eligible EnerChoice fireplace** • **FortisBC eligible ENERGY STAR water heater** • **Electric Heat Pump Water Heater** • ENERGY STAR windows and doors • ENERGY STAR heat recovery ventilator (HRV)	$750 Bonus Offer	• Complete the post-upgrade EnerGuide home evaluation, and submit all required rebate application forms, within 36 months of the initial pre-upgrade EnerGuide evaluation. • Each insulation upgrade must qualify for a minimum $150 rebate in one location. • Draftproofing upgrades must qualify for a minimum $150 rebate. • Must meet bonus offer requirements noted in **Home Renovations Rebate Program terms and conditions** to be eligible.

[1]Must be installed by a licensed contractor. [2]For electrically heated homes only. [3]Minimum HSPF of 8.5 and SEER of 15. [4]You can apply for a natural gas fireplace rebate either through the Home Renovation Rebate Program or FortisBC's EnerChoice Fireplace program, but not both. [5]You can apply for natural gas water heating rebates either through the Home Renovation Rebate Program or FortisBC's individual rebate program but not both. [6]The Energy Coach Home Evaluation Rebate is funded via a limited grant through the Province of BC Innovative Clean Energy Fund and will be paid on a first come first served basis according to the date the completed application is received until all available supplemental funds are exhausted.

*EnerGuide is an official mark of Natural Resources Canada

We're working together to help B.C. save energy.

BC Hydro Power smart | FORTIS BC Energy at work

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