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HOW THE WEST IS NOW

Renewable Energy Options Analysis
Summary

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The Renewable Energy Options Analysis

intends to fulfill a key objective of the Renewable Energy Framework Project:

Which renewable energy options are best suited for the Cochrane community?

The analysis takes a diverse approach on the notion of **'feasibility'** and **'suitability'**. For each technology we consider:

Siting Considerations

Environmental, social and economic benefits and drawbacks. These conditions often impact a project's social license, or level of acceptability within a community

Energy generation potential of the technology in Cochrane

Project economics, including capital costs, value of energy produced, simple payback period and internal rate of return

The economic and financial assumptions we used for our analysis are, as much as possible, specific to the Town of Cochrane and respective local energy service providers. These assumptions can have a significant influence on a project's total development costs, financial feasibility, and overall attractiveness as an investment opportunity. Electricity and natural gas rates are subject to uncertainty given Alberta's competitive market; should the market prices significantly shift, the viability of a renewable energy project will also change.

It is important to note that the presented scenarios are intended to illustrate the potential for renewable energy technologies in Cochrane. Project economics will vary depending on size, scale, and the suitability of the application. These are often best assessed on a case-by-case basis.

Benefits and Drawbacks of Renewable Energy

Traditional sources of energy, primarily fossil fuel energies like oil, coal and natural gas and large-scale hydroelectricity have significant environmental footprints, are becoming scarcer and more costly. Community-based renewable energy offer diverse environmental, economic and community benefits, and provide an opportunity to mitigate negative effects of traditional energy supplies. While all technologies have potential drawbacks, many can be mitigated through site specific considerations and best practices.

Key benefits for all of the technologies include:

- Environmental benefits as most renewable energy technologies produce little or no by-product such as greenhouse gases, air pollutants or other chemical pollutants; reduced water use and risk of contamination, reduced land use impacts, and minimal material waste production;
- Enhance the vibrancy of the local economy;
- Enhance local energy security;
- Revenue generation for local government from the sale of community produced energy;
- Retrofit or renew local infrastructure since many renewable energy projects can be incorporated into existing community infrastructure;
- Support more livable and vibrant communities as denser, compact communities are generally more amenable to community energy projects;
- Produce new partnerships and collaborations;
- Promotion of lifestyle choices surrounding reduction of environmental impact/footprint;
- Enhance local awareness regarding renewable energy or energy alternatives;
- Reduced dependence on ‘traditional’ sources of energy.

Solar Hot Water

Impacts are Negligible

Solar PV Power

Impacts are Negligible

Efficiency of Systems & High Capital Cost

Geoexchange

Possible Groundwater Contamination & Land Disturbance

High Capital Cost & Electricity Required (can be costly)

Impacts are Negligible

Wind Power

Possible wildlife death from impact with blades (Birds & Bats)

High Capital Cost

Varies Depending on Size & Scale

Potential impacts include: Shadow flicker and Sound (both can be a nuisance and/or impact health), Visual impacts, Health impacts

Biomass Heating

Possible Impact to Air Quality & Land Disturbance

Long-term Availability of Fuel Supply & Complex Ownership & Rate Structures

Construction of Distribution Pipes

Environmental, Economic, Social

Potential Challenges of Renewable Energy Technologies

Wind

The feasibility of a wind project is primarily dependent on the wind speeds at the location and proximity of the site to where the energy will be used. Wind speeds can be optimized by increasing the height of the turbine and selecting the windiest areas.

A preliminary assessment of the wind resource in Cochrane indicates average wind speeds of 4.4 – 6.4 m/s, and is considered to be marginal – poor quality. However, actual wind speeds will vary depending on site specific characteristics.

Both the 10 kW and 50 kW wind project scenarios would not likely be economically viable to the average homeowner or for the Town of Cochrane to consider due to the high capital cost and relatively low power output of small wind turbines. Both sizes of projects have a significant payback periods and a negative return on investment. It may be that smaller wind turbines (i.e. < 5 kW) are more economically viable in different circumstances. Rules and regulations for these types of turbines will be addressed in the policy framework.

In the 50 kW scenario a sensitivity analysis indicates that the project could yield a positive return on investment if capital costs are reduced by 25% or electricity export rates increase by 50%.

Solar PV

The feasibility of a solar energy project depends on the local solar radiation, site shading conditions, local climate conditions, value of electricity, and interconnection with the electrical grid. To maximize the electricity generated by solar panels, the panels should be in an area that is unshaded and allows for optimal orientation.

The price of solar PV equipment has reduced significantly over past decade and for many homeowners solar PV represents an attractive investment. Consider that between 2006 and 2011, the installed PV capacity in Canada grew from 20.48 MW to 558.74 MW. In addition, the cost of PV modules has steadily decreased from $5.36/Watt to $1.52/Watt in the same period.[1] Since solar PV projects can be scaled to any size, so too can the investment into solar PV based on budget availability.

Cochrane has one of the best solar resources in Canada.

[1] *Natural Resources Canada. 2014. Environmental Health and Safety Impacts of Photovoltaic Technology. Available at: http://www.nrcan.gc.ca/energy/publications/sciences-technology/renewable/solar-photovoltaic/11934*

Based on the scenario assumptions, both residential and commercial solar PV projects in Cochrane could be economically viable depending on the economic expectations of the individual or organization. For example, a 5kW residential system involves an upfront capital cost of about $20,000, annual costs of $100. Electricity generated from the systems is valued at about $1,000 per year. The case could become better if the project can be delivered without requiring the contingency or the system is constructed in a new building where some of the engineering costs are avoided and would be considered part of the overall design.

	50-kW Wind	10-kW Wind	10-kW Solar PV (Commercial System)	5-kW Solar PV (Residential System)
Energy Production Cost	$277 / MWh	$602 / MWh	$127.8 / MWh	$120.7 / MWh
Internal Rate of Return	-2.1%	-8.4%	5.2%	5.7%

Solar Hot Water

In Cochrane, solar hot water could provide up to 60% of a family's hot water needs. New homes built to be 'solar ready' offer an inexpensive way of setting the stage for future solar development. Panels can be installed at a much lesser cost when the prices decrease further.

Geoexchange

Geoexchange systems can be installed almost anywhere; however, generally areas with bedrock, till, and lacustrine deposits are more cost effective to drill. In Cochrane, the material deposited on the upland regions is till, and the lowlands is lacustrine making these areas potentially favourable for this technology. Based on the scenario assumptions, a residential geoexhange project in Cochrane would not likely be economically viable. Significant barriers include the relative low cost of natural gas combined with an increased adoption of high efficiency natural gas furnaces. The carbon intensive nature of Alberta's electricity grid makes it difficult for geoexchange projects to offer a cleaner energy source given the electricity requirements of these systems.

Natural gas is a relatively cheap fuel, which makes it challenging for heating projects such as solar hot water or geoexchange to compete with conventional, high efficiency furnaces. In BC, local governments are starting to require new homes to be constructed 'solar hot water ready' which makes eventual conversion to using solar hot water systems easier and less expensive. These bylaws provide a way of making it easier to transition to renewable energy if, and likely when, the costs of natural gas increase.

Biomass Heating

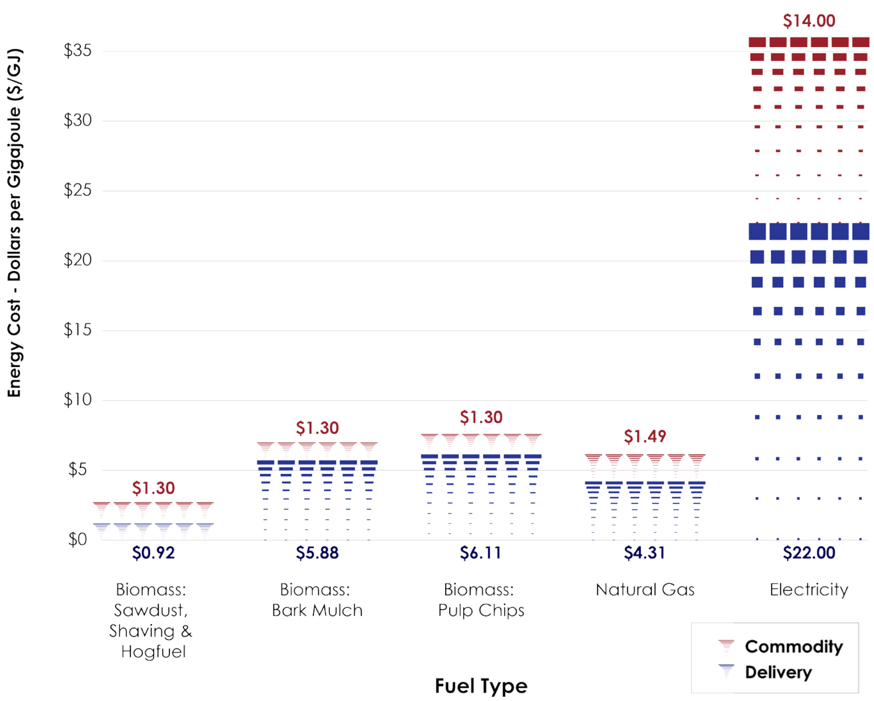
To develop a biomass heating project, it is first and foremost important to identify a secure and sustainable biomass source. Important characteristics of a sustainable feedstock are: availability, affordability, quality, and consistency.

Three potential sources of biomass near Cochrane were investigated: Spray Lake Sawmills, Brooks Sawmill, and wood waste collected at the Cochrane Eco Centre.

Staff at Spray Lake Sawmills, Brooks Sawmill, the Cochrane Eco Centre were contacted to determine details related to the types of products available, their quality, price, and quantity. The results are summarized in the graph below and show that mill waste such as sawdust, shavings and hog fuel could be available for approximately 60% less than the current price of natural gas and over 90% less than the price of electricity.

Although a specific biomass heating project has not been identified in Cochrane, for illustrative purposes project economics of a potential bioenergy project for a generic new commercial building 3.000 m2 in size was evaluated.

Based on the scenario assumptions, developing a biomass heating system may not be economically viable. Although the relative cost of biomass is low compared with natural gas, the incremental capital costs of the system and that there are no efficiency savings to be gained, make it more difficult to yield a viable business case.



A lower cost biomass fuel source (or even one where revenues could be gained for disposing of wood waste), higher natural gas prices and a project with higher energy consumption could potentially yield a positive business case.

In general, biomass projects could be very viable with a use of a district energy distribution system that links multiple buildings to a central plant. The feasibility of these systems are more attractive in dense areas. The City of Vancouver is starting by developing the district energy distribution network in high growth areas using systems supplied with natural gas. When renewable sources become economically viable, the systems can be more easily transferred.

Air Quality

With biomass heating projects, it is often the case that air quality conditions improve. This can be attributed to two key factors. Firstly, emissions from a single, well-managed facility are typically less than stack emissions from boilers and other heating units from individual buildings. Secondly, these systems can often lead to air quality improvements given the availability and opportunity to install best available technology emissions control equipment. Such equipment is often not required or too expensive for individual building boiler and heating systems.

Pressure Reducing Values

The Town also explored the feasibility of installing in-line turbines within existing water and wastewater infrastructure at sites throughout the community that have pressure reducing values. The exploration revealed that it is not feasible to install in-line turbines as there was insufficient flow to produce electrical power and recoup potential capital costs.

Conclusions

The results of this renewable energy options analysis confirm what has been suspected: small scale renewable energy projects don't have great economics and the value these projects offer to communities are more intangible. Solar photovoltaic projects offer the best energy generation potential and offer the greatest possible return on investment. Solar panels have been steadily decreasing in price over the last decade and these costs are expected to continue to fall as uptake increases. As well, solar projects offer few drawbacks in terms of environmental, social or community impacts.

Small wind projects can be expensive to install and operate, and in some cases these systems can present environmental, social, or community challenges. At the same time, small wind systems appropriate for an urban setting can be incorporated unobtrusively and can offer important benefits to a development.

Renewable energy technologies that replace systems using natural gas - such as solar hot water or geoexchange - are currently expensive considering the low cost of natural gas. However, in the case of solar systems, new homes built to be 'solar ready' offer an inexpensive way of setting the stage for future solar development.

While the biomass heating project assessed in this project did not generate a positive business case, it is likely that biomass heating could be viable in high density areas such as the downtown and where several buildings are connected to one system (district heating model). It may be that a system fueled by natural gas could provide a stepping stone by utilizing the distribution technology, and the fuel source could be changed when economic conditions become more favourable. This option should be evaluated in greater detail during the planning stages for future development projects expected in the downtown core.

In order to accelerate the uptake of small-scale community based renewable energy technologies there will be a need to deploy creative techniques to support strong business cases for these projects. We recommend the focus of these efforts centre on solar photovoltaic and future district energy with biomass as a fuel source. The Town may also need to consider financial incentives to encourage the uptake of these technologies.