Community Energy in Western Canada:

Insights from case studies on small-scale renewable energy development

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Abstract

With advances in renewable energy technology, decentralized and community scale energy projects are becoming more common. Rural and remote communities have unique interests in renewable energy as a source of revenue and a cost-saving measure to alleviate dependencies on more expensive alternatives. Other communities are interested in renewable energy as a component of sustainability objectives or as an opportunity to demonstrate innovation. Given these motivations, community energy is gaining interest. In this report, we define community energy and provide brief descriptions of 26 community energy projects in western Canada. Additionally, the report provides more detail on five community projects that include solar, wind, hydroelectricity, biogas, and geothermal technologies. The report highlights the design of community projects with attention to scale, ownership structures and links to community strategic plans. Case studies also illustrate challenges including economic sustainability and resistance to decentralized energy production from larger energy providers.

Introduction

Rural communities, along with small cities and towns, across Canada are an important part of the Canadian landscape. These places are closely linked to primary sectors of the economy such as agriculture, energy and forestry. Yet they are also linked to crucial processes for all Canadians, such as food production, environmental health, and recreation. Although rural communities remain vital to the Canadian economy, many places are struggling to maintain populations, viable employment opportunities, rural livelihoods and the local amenities that can attract and retain residents. Recent analysis of census data shows that rural communities and small towns are maintaining or declining in population in some areas of the country, but all rural areas are falling behind population gains in urban areas of the country. (Bollman and Clemenson, 2008).

Given these challenges, a recent report urges rural communities to actively plan and invest in their futures (Canadian Rural Revitalization Foundation, 2015). One such area of community investment is renewable energy. Community owned renewable energy offers an alternative to conventional systems of energy production and provision (St. Denis & Parker, 2009). The goals of community ownership of renewable energy range from economic stability through financial returns, place-based community development, energy security, and greater overall democratization of energy systems (Brisbois, 2019). Energy transition is as much a transformation of our social systems at it is of our systems of energy provision. Through community energy, citizens, communities, and municipalities are positioned as active and

engaged participants in renewable energy infrastructure, granting authority over the provision of energy that affects their daily lives.

Walker & Devine-Wright (2008) understand community energy on a spectrum encompassing both project outcomes and project processes. The *process dimension*, in reference to who develops, runs, and influences the project, ranges from an open and participatory, to a closed and institutional process (Walker & Devine-Wright, 2008). The *outcome dimension* is concerned with the distribution of economic and social benefits, and spans from distant and private, to local and collective outcomes (Walker & Devine-Wright, 2008).

Community energy projects are categorized by open and participatory processes, with outcomes distributed at the local level (Walker & Devine-Wright, 2008). Walker & Devine-Wright (2008) describe the ideal community energy project as "entirely driven and carried through by a group of local people and which brings collective benefits to the local community (however that might be defined)—a project that is both by and for local people" (p. 498). Community energy projects can be 100% community owned or developed in collaboration with the private sector (Walker, 2008).

Following the literature, this report illustrates community energy projects in two categories. *Citizen community energy* refers to those projects owned by a community of individuals or residents. Within this category, communities are understood as either communities of interest, or communities of locality (Walker, 2008). The former refers to individuals who share a common interest but who are not within local proximity to one another, such as a cooperative (Walker, 2008). The latter refers to individuals within geographic proximity to one another, such as a neighbourhood or First Nation (Walker, 2008).
Expanding on types of citizen energy projects, Walker (2008) identifies four community energy models.

- *Cooperatives* follow a membership-based system, and those members are encouraged to buy shares to finance the project.
- *Community charities* consist of an association with charitable status that provides facilities for the local community, such as a community league hall.
- *Development trusts* have been used to represent communities' interests in revenue-generation enterprises.
- *Share ownership* involves individuals as shareholders. This can occur through gifting a share or a piece of infrastructure, such as a wind turbine, to a community organization or trust.

Becker et al. (2017) echo this model, identifying that community energy projects can take organizational forms such as energy cooperatives, collective associations under private law,

local shares in energy infrastructure, and approaches to municipal ownership of energy grids and power plants.

Community energy is also categorized a *municipal community energy projects*, where the project is owned by a municipality and the benefits are accrued directly to the municipality (Becker, Kunze, & Vancea, 2017).

Community acceptance of renewable energy projects is rooted in the elements of procedural justice, distributional justice, and trust (Shaw et al., 2015). Procedural justice refers to the fairness and transparency and the decision-making process (Shaw et al., 2015). Distributional justice refers to the equitable distribution of costs and benefits (Shaw et al., 2015). Trust is understood as the level of trust in information and intentions of actors outside the community, the competence of governments and organizations, and the degree to which these parties share similar values with community members (Shaw et al., 2015). Community energy projects are associated with a high degree of procedural justice, distributional justice, and trust.

This report highlights specific instances of communities engaged in the ownership of renewable energy infrastructure. The report includes a brief description of 26 cases of community owned energy in Western Canada. Wherever possible, we attempt to illustrate renewable energy technology that is associated with smaller communities and towns, but in a few cases we also highlight larger cities as well. To further enhance our understanding of the opportunities and constraints associated with community energy, the authors selected five of these projects to provide more in-depth insight into the development and operation of each project. This case study approach is useful in understanding the local context of each case. Five cases of community energy include:

- SunMine - Kimberley, British Columbia
- Box Springs Wind Farm - Medicine Hat, Alberta
- Winchie Creek Hydro - Tla-o-qui-aht First Nation, British Columbia
- Regina Landfill Gas to Energy Project – Regina, Saskatchewan
- Canoe Reach Geothermal Project - Valemount, British Columbia.

In line with the research interests, this report details the ownership structure of each community energy project, the contributing factors to the development of these projects, key sources of information and expertise that guided these projects, significant achievements and challenges, and the future directions of each project. Of these five case studies, there are three cases of municipal community energy, one case of citizen community energy, and one case in development with an ownership structure still to be determined.

The report reveals that community energy projects represent an avenue for economic diversification in formerly resource-based communities turned destinations for tourism and outdoor amenities, such as Valemount and Kimberley. Often these projects can be situated on reclaimed industrial land, such as SunMine's position on the reclaimed site of the Teck Resources Sullivan Mine, once the largest lead-zinc mine in the world.

Community energy projects are positioned in areas of high renewable potential, or in areas where the precedent of community renewables is high. SunMine is situated in the Kootenay Region of southeastern British Columbia, the area with the greatest solar potential in the province. Winchie Creek Hydro follows the development of two other run of river hydro projects owned by the Tla-o-qui-aht First Nation, and additional run of river projects owned by the nearby Hupačasath First Nation.

Community energy projects also have great potential when located in remote communities that experience an unreliable supply or power, or shipments of necessary goods and services, such as produce. Future research will explore the motivations and barriers experienced by citizens and municipalities that inform the adoption or non-adoption of community energy projects.

This report is part of a larger project carried out through the University of Alberta's Future Energy Systems, titled Measuring the Costs and Benefits of Energy Transitions, and supported by funding from the federal government's Canada First Research Excellence Fund. Project information about renewable energy in Canada, including an interactive map of renewable energy projects is located here:

https://www.futureenergysystems.ca/research/system-wide-enablers/communities-aboriginal/measuring-the-costs-and-benefits-of-energy-transitions

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Community Energy Projects

In this section, we summarize 26 community energy projects organized by the following renewable energy technologies: wind, solar, hydro-electricity, biomass and geothermal. In each example below, we highlight the technology and scale of the project with emphasis on the link to community ownership, decision-making and benefits. We emphasize projects in rural and small towns but we also highlight deployment of technologies in a few larger cities. This section includes both operational projects, and projects that are currently in development stages. Not all of these projects are successful, hinting at the challenges of effective implementation and long-term sustainability.

Wind

Box Springs Wind Farm

In 2014, the City of Medicine Hat installed three seventy-eight metre tall wind turbines, provided by Gamesa Technology Corporation. Each turbine generates 2 MW at full capacity, for a total of 6MW. The Box Springs Wind Farm is located approximately ten kilometers outside the city centre. Designed to best capture the prevalent winds of southern Alberta, each turbine head can complete a full rotation up to nineteen times per minute. Through a public-private partnership, the project was developed by Box Springs Power Corporation, a subsidiary of WindRiver Power Corporation. This project accounts for three percent the electricity needs of the city's 63,000 residents, thus eliminating 10,400 tonnes of annual emissions. Under this public-private partnership, the city benefits from the generation of approximately 16,000 MWh annually, or enough electricity to meet the needs of around 2000 homes. The carbon credits associated with this project are also well aligned with the goals of the municipality to offset emissions from natural gas electricity generation. After a twenty-year period, the city has the option to take over as the sole owner of the project, further contributing to the energy independence of the municipality in the long term.

Nulki Hills Wind Farm

Nulki Hills is a joint wind energy project between Innergex Renewable Energy Inc. and the Saik'uz First Nation of central British Columbia. While the project is still undergoing a BC Environmental Assessment, the proposed project has an expected capacity of 210 MW. In the planning process, the two proponents completed a Letter of Intent, and Traditional Knowledge Protocol Agreement which outlined terms of agreement which allow for increased consultation

and positive relationship building between the two entities. The project will be a 50-50 partnership between Innergex and Saik'uz First Nation.

Zonnebeke & Sukunka Wind Energy Projects

Developed in a Limited Partnership between Natural Forces and West Moberly First Nation, the Zonnebeke Wind Farm is being constructed in the Peace River Regional District. This wind farm will be approximately four turbines when complete and have an energy generating capacity of 15MW. The exact models used for the project are not yet determined, but possible models have an approximate blade length of 70 m. Natural Forces lists a series of "community benefits" on their project website ranging from a spike in demand for services in the community during the initial phases accompanied by construction jobs, to a "small number of permanent positions" after construction is complete (Natural Forces, 2019). Natural Forces is also involved in a partnership with the Saulteau First Nation to develop the Sukunka Wind Energy Project. This project is being developed through the Sukunka Wind Project Limited Partnership, a partnership between Natural Forces and Saulteau First Nation. These proposed projects will generate a combined capacity of 30 MW for the provincial electricity grid. The proposed sites of Zonnebeke and Sukunka are located approximately sixteen kilometres south of Chetwynd, British Columbia. The most recent update from August 2018 states that flagging and tree clearing for geotechnical surveys has commenced, with road construction scheduled to be underway in September.

Solar

Bassano Solar Project

As of 2015, the Green Acres Hutterite Colony is home to the largest solar farm in Western Canada. Green Acres farms 20,000 acres, runs hog and chicken operations, and owns Crowfoot Plastics, a plastic recycling facility located just outside Bassano, Alberta. More than 7600 260-watt south-facing solar modules offset the entire energy needed for these operations. The 2MW project represents 25 percent of Alberta's 8MW total solar output. The project was developed and installed by SkyFire Energy, with help from colony members in order to reduce costs to $2.40 per watt. Green Acres Hutterite Colony retains complete ownership of this $4.8 million investment. The project is well aligned with colony's goals of self-sufficiency, as exemplified in the production of their own meat and vegetables. The investment has an expected payback of ten to fifteen years.

Kimberley SunMine

In the summer of 2014, Kimberley (pop. 7500) began construction on Canada's largest solar tracking facility. The City of Kimberley's SunMine now maintains 4032 solar cell nodules, mounted on 96 solar trackers that track the sun throughout the course of the day. The project is located on the reclaimed Teck's Sullivan Mine Concentrator site. Closing in 2001, this was once the largest lead-zinc mine in the world. To make the most of this south facing location, the municipality worked with EcoSmart Foundation to develop the project, ultimately receiving $1 million in funding from the Province's Innovative Clean Energy (ICE) Fund. The Columbia Basin Trust, the Southern Interior Development Initiative Trust, as well as $2 million loan from Teck, supported by seventy-six percent of residents in a 2011 referendum, also provided funding for the project. This is the first re-development of a large-scale reclaimed mine site into a solar project, and the first solar facility developed, owned, and operated by a municipality in Canada. SunMine is owned by the citizens of Kimberley and is aligned with goals to portray the city "as an environmentally conscious, amenity-rich destination to increase tourism and attract lifestyle migrants" (SunMine, n.d.). In the long term, SunMine signifies the potential for solar development in the region, fostering economic growth and diversification.

Medicine Hat Solar Thermal Project

The construction of this 1 MW solar thermal power plant was completed in 2014. Owned by the City of Medicine Hat, this project is situated in an area of high solar potential, experiencing an average of 2544 sunshine hours and 330 days of sunshine annually. The project is part of a $10 million dollar green energy initiative in the municipality, supported by the provincial and federal governments, that also includes the nearby Box Springs Wind Farm. The plant consists of a Concentrated Solar Thermal (CST) demonstration system, in which thermal energy from a parabolic trough collector field generates steam. This solar steam, along with steam produced in a heat recovery steam generator, is directed towards two steam turbine generators to create heat. This CST system is the first case of this technology in Canada, and also the first case of CST in a northern climate. The mayor of Medicine Hat, Ted Clugston, has been quoted as saying that this is a forward-looking project that aims to save natural gas, in an area with a long history of reliance on the resource. The project was approved by council in 2009, when the municipality was in a more financially feasible position. Clugston has said that given the opportunity to move forward with the project today, council would likely choose not to approve the project. The project was anticipated to generate enough power to meet the needs of 150 homes annually, contributing to municipal objectives of twenty-five percent renewable energy capability by 2025. The project was also expected to strengthen to tourism

sector and contribute to the image of a progressive city. Reports from May 2019 reveal that project operations will not continue, and that the city is in discussions for an alternative use for the site, such as renewable energy innovation park. This project faced public criticism from the start for not 'paying off', and ultimately cost $6 million over the original budget. The project also ceased operations having fulfilled a requirement of providing a record of its operational data, which now resides with Alberta Innovates.

Hydroelectricity

Wuskwatim Generating Station

At a capacity of 211 MW, the Wuskwatim Generating Station was one of Manitoba's largest construction projects. The project provided jobs and training for individuals in nearby Indigenous communities and other residents of northern Manitoba over a period of six years. Other benefits from the project since its opening in 2012 include a source of revenue from the energy export market, as well as contributing to supplying Manitoba with renewable energy. The generating station is owned and operated by Wuskwatim Power Limited Partnership (WPLP). WPLP consists of representatives from the Nisichawayasihk Cree Nation (NCN) and the NCN-owned Taskinigahp Power Corporation (TPC), and Manitoba Hydro. This is the first project in collaboration between Manitoba Hydro and a First Nation.

Atlin Hydroelectric Project

The Atlin Hydroelectric Project emerged out of increasing concern around the use of diesel generators in this community of 400 residents. The electricity needs of the community required the delivery of one million litres of diesel fuel annually to this remote northwest corner of British Columbia. Concerns related to these emissions and the health of Taku River Tlingit First Nation (TRTFN) traditional territory led the community to pursue this 2.1MW hydroelectric project on Pine Creek. Opening in September 2009, this is one of the first small scale hydroelectric projects completely owned and operated by a First Nation. The project was conceptualized by Taku Land Corporation (TLC), a TRTFN-owned company, with technical support from Sigma and Synex Energy Resources. TLC transferred ownership to the TRTFN-owned Xeitl Limited Partnership, which now oversees operations. Xeitl Limited Partnership has a twenty-five year agreement to sell power back to BC Hydro. Due to its proximity to the Yukon, the community and Xeitl Limited Partnership is currently involved in the feasibility stage of the Atlin Hydro Expansion in order to sell power to the territorial grid in the Yukon.

Kitasoo Small Hydro

This micro-hydro power facility has been in service since the late 1970s. The system supplies power to the Village of Klemtu, located on Swindle Island, on British Columbia's north coast approximately 60 kilometres north of Bella Bella. After serving the community for twenty-five years, a study was conducted by Kerr Wood Leidal engineering firm to explore the feasibility for expansion in light of increasing energy demand from the growing population, as well as concerns for the existing aging infrastructure. With funding from then Indigenous and Northern Affairs Canada, ANCAP, and the province's Ministry of Energy Mines and Petroleum Resources, construction of a new intake, penstock, and powerhouse began in 2008, increasing the system's capacity to 1.7MW. Supplied by Baron Lake, the system is located 4 km from the village. The project remains owned, operated, and maintained by Kitasoo First Nation, with maintenance costs per household running approximately $47/ month. Backup power is supplied to the community through diesel generators, costing approximately $500/hour to run. The region is accessible only by seaplane, ferry, or other marine services, reinforcing the value of energy self-sufficiency for the community. Since the facility was installed, the community of 360 residents now owns and operates a seafood processing plant in the area.

Canoe Creek Hydro

Beginning operations in June 2010, Canoe Creek Hydro is Tla-o-qui-aht First Nation's first hydroelectric project. The facility is located in the Canoe Creek Watershed, in a catchment area between Port Alberni and Tofino, British Columbia. The project is majority owned by the Tla-o-qui-aht First Nation of Tofino, with a minority stake held by Swiftwater Power Corp. of Nanaimo, BC. Barkley Project Group currently oversees management of the project. The 6 MW project provides enough power to meet the annual electricity needs of 2000 homes across Vancouver Island through an agreement with BC Hydro. This EcoLogo certified project has positioned Tla-o-qui-aht First Nation as a leader in renewable energy and is well aligned with the community's vision of sustainable resource management. In 2010, Canoe Creek Hydro won the Project Excellence Award from Clean Energy BC. The project also received an Outstanding Business Achievement award for a Joint Venture Business from the BC Aboriginal Business Awards in 2012. In 2013, Tla-o-qui-aht First Nation received the Community of the Year award from Clean Energy BC for the dedication to renewable energy projects. The First Nation has hopes to use one of the downstream sites as a future salmon hatchery.

Haa-ak-suuk Creek Hydro

This 6 MW hydroelectric project is located in the traditional territory of the Tla-o-qui-aht First Nation of Clayoquot Sound. Haa-ak-suuk Creek Hydro is the Tla-o-qui-aht First Nation's second hydroelectric project. The project is owned by the Haa-ak-Suuk Creek Hydro Limited Partnership, with joint involvement of the Tla-o-qui-aht First Nation and Kennedy Power Corp. of Nanaimo, BC. The Limited Partnership has entered into a forty-year power purchase agreement with BC Hydro to provide Vancouver Island with enough energy to meet the annual needs of 2000 homes. Financing for the project was managed by Stonebridge Financial Corporation and the project began operations in 2014. The project is currently managed by Barkley Project Group of Nanaimo, BC. This low-impact energy generating facility has received a certification for environmental leadership from EcoLogo. Haa-ak-suuk Creek Hydro and the principles of renewable energy are well aligned with the First Nation's vision of sustainable forestry, fisheries, and ecotourism and overall goal of sustainable resource management in their traditional territory.

Winchie Creek Hydro

This run of river hydroelectric project has a capacity of 4 MW and is the third clean energy project in the Tla-o-qui-aht First Nation Economic Development portfolio. Winchie Creek is located on Vancouver Island in the Clayoqout Sound within the Tla-o-qui-aht traditional territory (Ha'wiih Haahoulthlee). This project is owned completely by the Tla-o-qui-aht, with support from the Barkley Project Group and financing from the then Aboriginal Affairs and Northern Development Canada's Community Opportunity Readiness Program (CORP), an initiative the provides financial support to First Nation and Inuit communities pursuing economic development opportunities. This is the first run of river hydroelectric project to be one hundred percent owned by a First Nation on Vancouver Island.

Barr Creek Hydro

The Town of Tahsis, British Columbia is situated on the Northwest Coast of Vancouver Island in the heart of Nootka Sound and within the ancestral territory of the Mowachaht/Muchalaht First Nation. After the closure of the local sawmill in 2001, this forestry town of 248 residents embraced a new identity as an ecotourism destination featuring a variety of outdoor recreation, such as sport fishing and wildlife viewing. The region saw the construction of the Barr Creek Hydroelectric Project begin in June 2010, being completed in November 2011. The project was commissioned by Synex International Inc, a public company

that oversees “development, ownership and operation of electrical generation facilities and the provision of consulting engineering services in water resources, particularly hydroelectric facilities” (Hydro News, 2010). The project is owned and operated by the Barr Creek Limited Partnership, of which Synex Energy Resources Ltd. hold an 80% ownership stake, and the Ehattesaht First Nation hold the remaining 20%. In 2012, a forty-year purchase agreement was established between the Barr Creek Limited Partnership and BC Hydro to permit the commercial generation of 4.4 MW of electricity to the provincial grid.

China Creek Hydro

Situated in the Greater Alberni Valley on the west coast of Vancouver Island, this 6.5 MW hydroelectric project utilizes non-invasive run of the river technology that follows the natural elevation of the creek and diverts a small portion of water to a spin a turbine and generate electricity. After evaluating ten potential sites within their traditional territory, the China Creek Hydroelectric Project was initiated by Hupačasath First Nation and Chief at the time, Dr. Judith Sayers. The community established Upnit Power Corporation and owns a 72.5% majority stake in the project. Other partners in the project include Synex Energy Resources Ltd. (12.5%), Ucluelet First Nation (10%), and the city of Port Alberni (5%). The project has produced two full time jobs in the region. Hupačasath First Nation’s motivation for pursuing the $14 million project is rooted in the history of proposed natural gas development in the Port Alberni region, and a desire to pursue emissions reduction initiatives. The First Nation’s majority ownership stake is also well aligned with the community goals of self-determination of their territory, land, and water. The project has been recognized with awards from the Alberni Valley Chamber of Commerce and the Nuu-chah-nulth Economic Development Corporation. Former chief and current Clean Energy BC board member Dr. Judith Sayers also received silver award from Canadian Environmental Awards in the Climate Change category for her involvement in the project.

Kwoiek Creek Hydro

Following a 2005 Development Agreement between Kanaka Bar First Nation and Innergex, the 49.9MW Kwoiek Creek hydro project began operations in 2014. Located on a tributary of the Fraser River, this run of river project sits approximately fourteen kilometres south of the town of Lytton, British Columbia. The Kanaka Bar First Nation holds a 50% stake in the Kwoiek Creek Resources Limited Partnership through their company, Kwoiek Creek Resources Inc. (KCRI). The developer Innergex Renewable Energy holds the remaining 50%

stake in the partnership. The first company established by the First Nation, the mandate of KCRI includes “anything and everything to do within our Traditional Territory on the west side of the Fraser River” or the Kwoiek and Hanging Valley watersheds (Kanaka Bar Band, n.d.). The project has been awarded an EcoLogo certification for its commitment to a reduced environmental impact. Kwoiek Creek hydro project is connected to BC Hydro’s Highland Valley Substation near Marmit Lake via a seventy-one kilometre transmission line, and supplies approximately 215 GWh of energy annually, enough to meet the needs of 22,000 homes in the province. The pursuit of renewable energy is well aligned with the value of Kanaka Bar First Nation and provides “an opportunity to exercise Nlaka'pamux rights and title in a modern way” (Kanaka Bar Band, n.d.).

Kokish River Hydro

With a shared commitment to sustainable development and protection of aquatic and terrestrial ecosystems, ‘Namgis First Nation and Brookfield Renewable Partners entered into the Kokish River hydroelectric project under the partnership Kwagis Power. The project is completely owned and operated by the partnership. The 45 MW capacity run of river project is located fifteen kilometres east of Port McNeill on northeastern Vancouver Island. The watershed has a long history of industrial activity, including logging, saw milling, and mining. Following the 1995 purchase of water rights interests by Brookfield Renewable Energy Partners, the first hydroelectric project in the region began operations in April 2014. The ‘Namgis First Nation has been an active participant in all phases of the project, from development to current operations, including participation in technical meetings and field studies, organization of public meetings, and hiring and management of an independent technical advisor. The community remains committed to efforts to ensure environmental protection, with studies of the river ecosystem, home to a variety of species of salmon and trout, beginning in 2004. The project was financed by a $175 million investment issued in 2012, making it the first hydroelectric project with First Nation ownership to have received support from the P3 (public private partnership) Canada Fund. Kwagis Power also received a $12.94 million loan in 2014. As of 2010, the project signed a forty-year Electricity Purchase Agreement with BC Hydro, enabling it to supply power to 13,000 homes in the province.

Biomass

Cedar Road Landfill Gas Utilization Facility

Initiated in 2006 by Cedar Road Bioenergy Inc., the Nanaimo Bioenergy Centre landfill gas (LFG) utilization facility (or The Cedar Road LFG Inc. Utilization Facility) is the first of its kind in British Columbia to target a small to medium sized municipality. Beginning construction in 2008 and going into operation in 2009, the facility is located within the boundaries of the thirty-seven hectare Regional District of Nanaimo's municipal landfill. Biogas from the site enters the facility to first be conditioned to remove moisture and adjust the temperature and pressure. The facility consists of two GE Jenbacher JGS 312 GS-L.L gas gensets which combust the landfill gas, for a combined electrical output of 1.3 MW. Phase one of the project, the electrical generation facility, was facilitated with an investment of $3.8 million from B.C. Hydro's Standing Offer Program. Phase two, beginning in 2011, enabled further biogas cleaning, compression, and electricity storage. This phase was supported by a $2.5 million capital investment and a $1 million grant from British Columbia's Innovative Clean Energy Fund (ICE). The facility has a twenty-year operating license with the Regional District of Nanaimo.

Hartland Landfill Gas Utilization Facility

The Hartland Landfill Gas Utilization facility is an example of a public-private partnership with both the Capital Regional District (CRD) and the Maxim Power Corporation stationed out of Victoria, British Columbia. The main goals were a reduction of GHG emissions, and to protect public health and safety. This project, like other landfill gas projects, uses waste-methane from the decomposition processes occurring within the landfill. In the 1990s the CRD installed a flaring system to dispose of the waste methane, and in 2003 this $2.8 million project was upgraded to the utilization facility we see today. The productive capacity of the power plant is 1.6 MW and will reduce emissions by approximately 83,000 tonnes of CO2, with a practical lifespan of 20 years. While the project ran into roadblocks in terms of financial viability, it countered this uncertainty with a "highly innovative financial model" and using the public-private partnership model for ownership. Historically, it is was only common for larger scale industrial projects to take on liquid fuel gas energy production, as the facility costs are quite high, but externalizing this process was not an option, as there were no such large-scale industrial projects close by on the island. The CRD owns 70% of the project, while Maxim owns the remaining 30%. Additionally, Maxim pays the CRD via lease payments, and Maxim is still responsible for the facility and its costs. The facility is designed to be able to accommodate a

second generator, which can be added if the CRD would like to increase their power production, and thus their royalties from power production.

UBC Nexterra Bioenergy Research and Demonstration Facility

The University of British Columbia's Bioenergy Research Demonstration Facility (BRDF) was initiated in 2009 as a collaboration between UBC Operations, faculty members, students and researchers, BC Hydro, Nexterra Energy Corporation and GE Power and Water. Operational since 2012, the facility is the first of its kind in North America. Each day, the facility processes waste wood from sawmill residuals, municipal trimmings and land clearing operations to generate up to 6 MW of thermal energy (steam) per hour, or a combination of 2.4 MW of thermal energy (heat recovery) and 2 MW of electricity. BRDF supplies 5% of the power for UBC's electrical grid, a quarter of the energy for campus heating, and eliminates 14% of campus greenhouse gas emissions from fossil fuels. The project construction also showcases cross-laminated-timber (CLT) products made in British Columbia, a low carbon, renewable alternative to steel. Located in a high-density environment near student residences, the project is an example of these facilities existing safely in an urban environment, with air quality having remained well below permitted limits. The $27.4 million dollar facility will generate a positive return on the University's $8.15 million investment by 2028, through annual savings to operational costs of $800,000.

Iona Island Wastewater Treatment Plant & Landfill Gas Utilization Facility

Opening in 1963, the Iona Island Wastewater Treatment Plant is located in Richmond, British Columbia. Since opening, the facility has expanded six times to accommodate for the growing population in the area, as well as upgrades to infrastructure. The plant is the primary point of treatment for wastewater for 600,000 residents from Vancouver, UBC, Burnaby, and Richmond. The facility breaks down organic matter from wastewater through a process of anaerobic digestion, producing biosolids and methane gas. The methane generated meets all of the heat and some of the energy required to run the plant, offsetting its greenhouse gas emissions by 390 tonnes annually. In 2012, the plant treated 207 billion litres of wastewater. Following the treatment process, the wastewater is released into the Strait of Georgia.

Regina Landfill Gas to Energy Project

The City of Regina established this landfill gas project in 2017. The facility collects methane gas from the municipal Fleet Street landfill, which is then reused to generate electricity for up to 1,000 homes. Owned by the municipality, the project redirects

approximately 30,000 tonnes of greenhouse gas emissions from the landfill. The City of Regina has established a twenty-year power purchase agreement to sell the electricity from the facility directly to SaskPower, powering up to 1,000 homes in the province. The project came in under the $5 million budget and contributes $1 million in annual revenue to the municipality. Regina's Mayor Michael Fougere has stated that the project represents a "commitment to reducing greenhouse gas emissions and seeking partnerships with organizations who are also committed to environmentally responsible action" (Redman, 2017). In 2019, the city received $1.3 million in funding from the federal government's Low Carbon Economy Fund in order to add thirty new gas wells to further reduce greenhouse gas emissions in the area.

Saskatoon Landfill Gas Collection & Power Generation System

The Landfill Gas (LFG) Collection & Power Generation System began generating electricity for the City of Saskatoon in March 2014. The $15 million project was jointly funded by the federal government's Canada-Saskatchewan Provincial-Territorial Base Fund, and the City of Saskatoon. The 1.63 MW project involves a clay capping on part of the landfill to prevent the release of the gas produced as the municipal waste decomposes. Twenty-nine vertical wells were drilled, as deep as 101 feet, to collect gas that consists primarily of carbon dioxide and methane. A network of 13,800 feet of underground pipeline transports the gas to be combusted in two 815-kilowatt Caterpillar engine generators at the power generation facility. As complete owners, the LFG project provides many benefits to the City of Saskatoon. The collection of landfill gas benefits the community with an annual reduction of 50,000 tonnes of emissions. The energy generation is enough to power 1200 homes in the community. After a nine-year period of selling energy to SaskPower to cover the costs of the project, the profits will contribute towards future renewable power generation initiatives.

Cache Creek Landfill Gas Utilization Project

The Cache Creek Landfill Gas Utilization Facility collects gas that is naturally emitted from the municipal landfill to generate 4.8 MW of power. The landfill underwent a $100 million, 42-hectare expansion in 2010 to extend the lifespan by 25 years. The landfill was therefore required to meet the 2009 Landfill Gas Management Regulation, provincial legislation that establishes criteria for gas capture from municipal solid waste landfills. This expansion was necessary as the site is a key disposal location for Vancouver, accepting around 30 percent of the region's municipal solid waste. Beginning commercial operations in March 2015, the project generates enough power to meet the needs of 2500 homes. This municipal project was funded

by Wastech Services Ltd., a private enterprise that entered into a twenty-year contract to sell power to BC Hydro under the Standing Offer Program.

Geothermal

Lakelse Geothermal Project

Located at Lakelse Lake, south of Terrace in British Columbia's northwest, the Kitselas Geothermal Power Generation Project, or Lakelse Geothermal, is underway. The project proponent is LL Geothermal Inc., a joint venture partnership formed between Borealis GeoPower and Kitselas Development Corporation (KDC), the body that manages the economic arm of the Kitselas First Nation. In 2014, LL Geothermal Inc. obtained a geothermal exploration permit from the provincial Ministry of Energy and Mines for an approximately 2865-hectare area near Lakelse Lake. The exploration revealed that the geological environment has "the requisite subsurface features to continuously supply, and replenish, high temperature brines that would support ongoing power generation" (Borealis GeoPower, 2013). Having now completed the pre-feasibility stage, the geothermal power generation project has the potential to be the first in Canada. Supported by British Columbia's First Nations Clean Energy Business Fund, Kitselas First Nation is pursuing private power purchase agreement partnerships with other project proponents in the region to move forward with the exploratory drilling stage of the project. The community is also supported by $10,000 in capacity funding from the province to establish private purchase agreements for the sale of electricity and thermal energy produced by the proposed plant. The proposed project is estimated to produce 15 MW of electricity, and up to an estimated 135 MW of thermal energy to heat local businesses. The project will necessitate 75 jobs throughout the construction process, as well as 15 longer term positions. The project will contribute to the energy security of the region, and is well aligned with Kitselas First Nation's future vision of a geothermal heated commercial greenhouse that will supply the community with a secure source of food.

Canoe Reach Geothermal Project

The Canoe Reach geothermal project is in development fifteen kilometres south of Valemount, British Columbia. This former forestry town has established a vibrant tourism industry due to its location in the mountainous landscape of the Robson Valley. This remote location makes this community reliant on hydro lines and shipping routes that come from Kamloops. Proponents of the Canoe Reach project include Calgary-based Borealis GeoPower

and the Valemount Geothermal Society, with additional support from Natural Resources Canada, the Canadian Geothermal Energy Association, Climeon, MMM Group, and the Dewhurst Group. As the project is currently in development, the ownership structure remains unclear at this time. Borealis GeoPower acquired geothermal tenure of this site in 2010, and pre-feasibility studies and geophysical surveys have since identified adequate subsurface temperatures of 200 degrees Celsius at a depth of 1000 metres. The project is set to proceed in three phases, starting with a hot spring facility and followed by 1 MW and ultimately 15 MW power facilities. The development plan will also include Borealis GeoPower's Sustainaville demonstration project, a commercial 'Geo-Park' including a brewery, greenhouse, fish farm, and biomass facility powered and heated by geothermal energy. This site will further expand the community's tourism sector, extend the growing season into the winter months, and demonstrate the potential of geothermal development to other municipalities. In May 2018, the British Columbia Oil and Gas Commission issued authorizations to Borealis GeoPower Inc. for four thermal gradient wells at the Canoe Reach Geothermal Project site, marking the first time an authorization has been granted under the new Geothermal Resources Act.

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Community Energy Case Studies

In this section, we provide more detailed case study content on five community energy projects. In these case studies, we highlight the incentives for renewable energy development, with attention to the availability and abundance of local renewable energy resources such as wind, sun, and hot water. We also highlight the link between community energy and community values and strategic plans. In each case, there is a broader vision and commitment to renewable energy that motivates and propels the project forward. As is noted in the earlier section of this report, there are many challenges in project implementation. Some of these challenges involve technical matters, such as linking local electricity production to the provincial electricity grid. But the technical challenges are relatively minor in comparison to local governance arrangements, often involving multiple communities, multiple levels of government and public-private partnerships. The behavior of incumbents, and resistance to decentralized and community-owned energy is also a part of experience for a number of these communities.

SunMine – Kimberley, British Columbia

Description of Community

The City of Kimberley is located in the Kootenay region of southeastern British Columbia. Situated in the Columbia River Basin, this landscape provides the province with a significant portion of its hydroelectric power. Home to 7,425 residents as of 2016, the City of Kimberley has its origins in the mining industry and the region was home to the Teck Sullivan Mine (Invest Kimberley, 2019). Operating for 100 years, this operation became the largest lead-zinc mine in the world for much of the 20th century, contributing to the growth of Kimberley's local economy as well as the overall identity of the community (SunMine, n.d.).

Description of Project

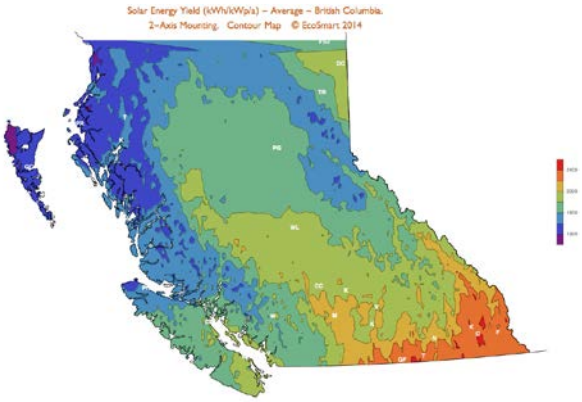
With the closure of Teck Sullivan Mine in 2001, the collective identity of Kimberley as a mining town shifted (SunMine, n.d.). The community is now home to SunMine, Canada's largest solar tracking facility and the first solar project to sell power to the BC Hydro grid (SunMine, 2017). This project consists of 4000 260-watt solar modules on 96 solar trackers (Skyfire Energy,

n.d.). The tracker technology allows the modules to follow the sun throughout the day, therefore maximizing the potential for solar exposure (SunMine, 2017). In 2010, Teck completed the reclamation of the former Sullivan Mine site on which SunMine is now located (SunMine, n.d.). Teck continues to be involved in the long-term care and maintenance of this reclaimed site, and provided the municipality with a loan of $2 million to contribute towards project development (SunMine, 2017, SunMine, n.d.). Other sources of funding included $1 million from the provincial Innovative Clean Energy (ICE) Fund, as well as support from the Columbia Basin Trust and the Southern Interior Development Trust. With this support in place, city council decided to move forward with construction of the project in the summer of 2014. This municipally owned project began operations in 2015, providing the city of Kimberley with 1.05MW of electricity generation from their solar resource. (SunMine, n.d.)

Construction of SunMine

Teck. (n.d.). SunMine Solar Farm Project at the Sullivan Site [digital image]. Retrieved from: https://www.teck.com/news/stories/2015/sunmine-solar-farm-project-at-the-sullivan-site

Contributing Factors



British Columbia Solar Energy Yield

EcoSmart. (n.d.). SolarMap-BC-Full-Contour [digital image]. Retrieved from: https://ecosmartsun.com/canadian-solar-maps-province/

In conversation with a community representative, it is clear that the project was created due to a perfect storm of contributing factors. First, Kimberley's location in the southeast Kootenay region allows it to access high solar energy potential. This solar resource warrants the development of a solar project in the region. Given the community's history as a mining town, the landscape around Kimberley is dominated by reclaimed mining areas. This available land acted as the necessary resource on which to situate SunMine. In addition to the

right environmental context for development of a solar project, public support from the residents of Kimberley created the right social context. The community exhibits a strong adherence to environmental values, and the projects reflects "the City's reputation as an environmentally conscious, amenity-rich destination" (SunMine, n.d.).

Leadership and Expertise

With these environmental and social conditions in place, the community was a prime candidate for development of a solar project. Michel Despot, owner of the Vancouver-based company EcoSmart, approached the City of Kimberley and Teck Resources with the proposal for SunMine in 2008 (Clean 50, n.d.).

Key Challenges

Personal communication with a community representative revealed key challenges throughout the timeline of Kimberley SunMine. First, the project lost a vital source of funding from the federal government's Western Economic Diversification Grant, as their program goals had changed (Personal communication, November 15, 2018). The city lost $1.6 million of funding support in the final stages of the planning phase, and the project was downsized from 1.65MW to the current 1.05MW (SunMine, n.d.). The working relationship with BC Hydro was also a source of some challenges. Fitting solar into the existing BC Hydro infrastructure proved challenging from an engineering standpoint. The community representative also referenced the prevalence of hydro power in the region and the approval of British Columbia's Site C hydroelectric project. BC Hydro's receptiveness to solar development remained low, with the potential of Site C and other hydroelectric projects to more than meet the energy needs of British Columbia.

Achievements to Date

As of June 2018, SunMine has generated $569,864. After annual debt payments on the $2 million loan, the surplus will go into a community reserve fund. The electricity generation supplied to BC Hydro is such that SunMine has the capacity to power 275 homes (Skyfire

Energy, n.d.). However, among the most notable achievements of Kimberley SunMine to date is the positive advertisement it has brought to the municipality. It has demonstrated that Kimberley is still alive after the closure of the Teck Sullivan Mine, and that it is a leader and innovator in the field of renewable energy (Personal communication, November 15, 2018). Kimberley has gone from a forgotten community, to a best practices community that other municipalities are looking to emulate (Personal communication, November 15, 2018). SunMine has generated over 2000 visitors to tour the site through SunMine ecotours (SunMine, 2017a).

SunMine

Kootenay Association for Science and Technology. (2015, August 31). SunMine Commercially Operating [digital image]. Retrieved from: http://kast.com/sunmine-commercially-operating/

Increasing visibility and awareness of solar within the community has kickstarted residents to begin installing solar projects on their homes (SunMine, 2017) (Personal communication, November 15, 2018). The municipality is currently building their first electric car charging station under a solar powered carport (Personal communication, November 15, 2018). The achievements of SunMine have been recognized with many national and provincial awards, including the 2015 Community of the Year Award by Clean Energy B.C., the 2016 Sustainability Award from the Association of Professional Engineers and Geoscientists of BC, and the 2017 Clean 50 award for outstanding contributions to clean capitalism (SunMine, 2017b). While there was no official partnership with Indigenous communities in the region, Kimberley signed a memorandum of understanding with the ʔaq̓am Band, part of the Ktunaxa Nation, and the First Nation expressed interest in the development of their own solar project (ʔaq̓am, n.d.; Personal communication, November 15, 2018).

Links to Community Objectives

SunMine is well aligned with the vision and community objectives of the city of Kimberley. The Official Community Plan for the city of Kimberley suggests that Kimberley supports “innovative means of increasing tourism” in order to “expand and diversify the economic base through new economic opportunities that compliment a lifestyle community,

and maintain the desirable cultural, environmental, recreational and social characteristics of the community" (SunMine, n.d.).
The project is multi-faceted in its contributions to the local economy,
population, and identity. Community awareness that their dependence on mineral resources would eventually come to an end led to the development of a vibrant tourism and recreation industry (SunMine, n.d.). The city has always focused on economic diversification, through the development of a ski hill, championship golf courses, an award-winning campground, and the Kimberley Conference and Athlete Training Centre (SunMine, n.d.). Diversifying further into the utility business was a natural transition given the contributing factors at play (Personal communication, November 15, 2018). This is reflected in the high level of public support exhibited in a 2011 referendum when 76% of voters supported the municipality borrowing $2 million for the construction of SunMine (SunMine, n.d.). SunMine represents a signal to national and global audience that Kimberley is "a good place to be" (SunMine, n.d.).

SunMine

Skyfire Energy. (n.d.). Commercial Case Studies [digital image]. Retrieved from: https://www.skyfireenergy.com/case-study-business/1-05-mw-sunmine-kimberley-bc/

Kimberley seeks to increase its population by welcoming "lifestyle-driven mobile workforce who can choose to live and work from anywhere" (SunMine, n.d.). This population growth will result in more consumers to support the increasing local business sector (SunMine, n.d.). Kimberley also hopes that by highlighting the solar potential of the region, SunMine will competitively position the city for future development of renewables in the region. More development of the solar resource will increase demand for solar goods and services and continue to generate jobs in the region (SunMine, n.d.).

Future Directions

SunMine's mandate as a community-owned renewable energy project will likely cease to continue. While the project has inspired many positive changes and achievements for the

community, the City of Kimberley and Teck have agreed to the sale of SunMine to Teck for the price of the City's outstanding loan balance, approximately $2.05 million (SunMine, 2017a). The city identifies issues with operational costs and issues with expansion of SunMine as the reason for the proposed sale. Kimberley anticipates increasing costs to maintain the solar tracking technology that would require subsidization from city taxation, and relying on financial support from taxpayers is not consistent with the vision for SunMine (SunMine, 2017a). Additionally, the city is required to provide 2MW to BC Hydro as per an Energy Purchase Agreement. Due to the loss of funding, the project is only meeting 1.05MW of that requirement. Other infrastructure priorities for Kimberley mean that investment in the expansion of SunMine is not financially feasible at this point. In a referendum in mid-October 2018, electors were asked "Are you in favour of the City of Kimberley selling the assets of SunMine to Teck Metals Limited for fair market value?" (SunMine, 2017a). While the results of the referendum are unknown, the community representative stated that the municipality is currently engaged in due diligence to determine the financial feasibility for TEK to take over ownership of SunMine (Personal communication, November 15, 2018).

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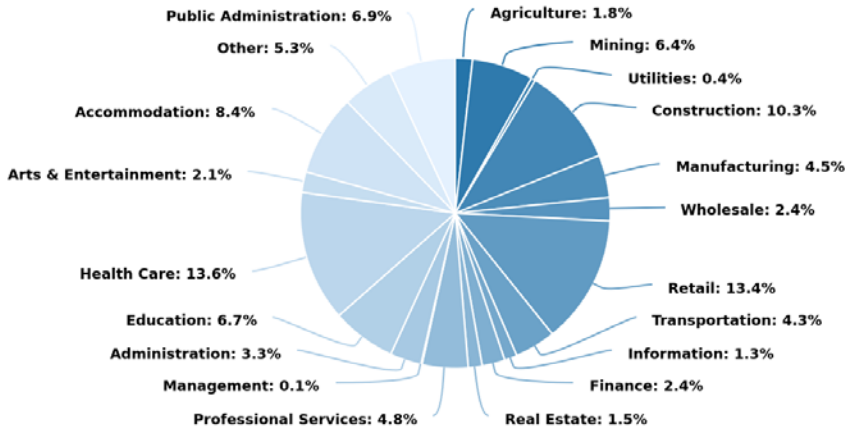
Box Springs Wind Farm – Medicine Hat, Alberta

Description of Community

Medicine Hat is a city located in southeastern Alberta, on the banks of the South Saskatchewan River. In 2016, the federal census recorded a population of 62,935, a 5.6% increase from 2011 (Statistics Canada, 2017). Medicine Hat has an older population, with a median age of 40.5, relative to the provincial median of 36.7. Median income for the city of Medicine Hat in 2015 was $73,150, below the provincial median of $93,835 (Statistics Canada, 2017).

Medicine Hat's economy was historically driven by the discovery of natural gas in the area in 1905 (Invest Medicine Hat, n.d.a), earning its nickname as "the Gas City". Medicine Hat's modern economy is driven by a number of key economic sectors; one of which is agribusiness, with adjacent farms that grow canola, hemp, and pulses (Invest Medicine Hat, n.d.b) and plans by Aurora Cannabis to develop a new 1.2 million square foot greenhouse cannabis production facility, generating 450 permanent positions and resulting in a significant economic impact (Invest Medicine Hat, 2018a). Other economic drivers include an aerospace and defense business cluster, leveraging Medicine Hat's strategic position near Canadian Forces Base Suffield, Defence and Research Development Canada, and Canada's first beyond-line-of-sight UAV range (Invest Medicine Hat, n.d.c). The city also hosts petrochemicals processing,

leveraging Medicine Hat's abundant natural gas reserves and experienced labour force (Invest Medicine Hat, n.d.d). Significant economic drivers are detailed in the graph below, presenting labour force by industry.



Medicine Hat Labour Force by Industry

Invest Medicine Hat. (2017, November). Labour Force by Industry [digital image]. Retrieved from: https://investmedicinehat.ca/report/by-the-numbers/

Energy in Medicine Hat

Since the discovery of a large reserve of natural gas near Medicine Hat, the city has used natural gas for heating and electricity production (Electricity and Natural Gas Retailers in Medicine Hat and Outlying Areas, n.d.). The City of Medicine Hat operates a municipal electric utility, responsible for the generation, transmission, and distribution of electricity to approximately 30,000 customers in the city and outlying towns and rural areas (City of Medicine Hat, n.d.a). This situation is unique in Alberta, as Medicine Hat is the only municipality that owns its power generation (Gallant, 2016). The municipality is only allowed to produce the energy to meet their own needs, although capacity often exceeds usage and excess energy is sold to the provincial grid (Gallant, 2016). The energy division at the city generated $94 million in revenue in 2014 from its investments (Bakx, 2015). The City Electric Utility has a generation capacity of 246 MW (City of Medicine Hat, n.d.b).

Medicine Hat is also becoming a nexus of renewable energy development. In 2018 and 2019, several utility-scale solar and wind farms are proposed or in development in or near the region (Invest Medicine Hat, 2019 and Invest Medicine Hat, 2018b). The city is committed to utility sustainability, with the HAT Smart environmental initiative, through which the city offers

a rebate of $0.75 per watt of solar panels installed, to a maximum of $5,000 (City of Medicine Hat, n.d.c). In 2018, 100% of the allocated $135,000 for solar electric projects was utilized (HAT Smart Funding Update, 2018). Since 2008, the program has provided $647,074 across 17 rebates for solar panel construction atop commercial buildings and $612,507 across 151 rebates for residential solar installations (City of Medicine Hat, n.d.d). Medicine Hat College is in the process of developing a renewable energy microgrid facility, the Community Renewable Energy Microgrid Demonstration Project (Invest Medicine Hat, 2018c). With federal and provincial funding, this project is anticipated to support a solar canopy, two electric car charging stations, and four vertical solar and wind turbines (Invest Medicine Hat, 2018b). The College is working with local firm Terralta Inc. and ENMAX to develop the project (Invest Medicine Hat, 2018c). This project is anticipated to produce 170 MWh in the first year (Medicine Hat College, n.d.).

The city has also invested in several renewable projects themselves, including a 4.5 kW solar generator atop the Medicine Hat public library (City of Medicine Hat, n.d.e), a 6.2 kW solar generator atop the Family Leisure Centre (City of Medicine Hat, n.d.f), the recently decommissioned 1 MW Concentrated Solar Thermal demonstration project (City of Medicine Hat, 2019), and the 6 MW Box Springs Wind Farm, described in the following section (City of Medicine Hat, n.d.h).

Description of Project

The Box Springs Wind Farm, completed in 2014, is comprised of three wind turbines each with a capacity of 2 MW. The project is Public-Private Partnership (P3) between the city and the Box Springs Wind Corporation (City of Medicine Hat, n.d.h). The project is located on two quarter sections of land in the northern areas of the city boundary (ClearSky Engineering Inc., 2019). This land was formerly used for grazing by one individual and for natural gas wells and pipelines. The city anticipated that these activities would continue while the turbines are in operation (City of Medicine Hat, 2012a). There was no residential development within 1 km of the turbine sites (City of Medicine Hat, 2012a).

As per this partnership, the turbines were built and maintained by the Box Springs Wind Corporation, subsidiary of Wind River Power, while the city has agreed to purchase energy generated for a 20 year period (City of Medicine Hat, n.d.h), after which the city has the opportunity to acquire 100% ownership of the project for no cost or require Wind River Power Corporation to decommission and reclaim the land at their expense (City of Medicine Hat, 2012b).

Box Springs Wind Farm

Dodge, D. (2014, September 29). Box Springs Wind Farm [digital image]. Retrieved from: https://www.flickr.com/photos/greenenergyfutures/15751669776

The project is expected to produce 16,000 MWh over an average year, meeting about 3% of the city's energy demand (City of Medicine Hat, n.d.h). As of May 14, 2019, the project produced a total of 1,672,034.6 kWh (City of Medicine Hat, n.d.h).

Development Timeline

The development of the project can be traced as far back as 2003, when the City of Medicine Hat's Annual Report mentions that the city has developed the Going Green program to support wind electricity generation (City of Medicine Hat, 2003). In the following year, the 2004 annual report states that the City of Medicine Hat has started to monitor wind capacity to determine the feasibility of wind energy generation in Medicine Hat (City of Medicine Hat, 2004).

In 2007, the City of Medicine Hat annual report mentions that work is ongoing on the Box Springs Wind Farm (City of Medicine Hat, 2007). According to the Annual Report for the next year, in 2008, the city was in the process of conducting a noise study and an environmental assessment, with the goal of bringing a decision item to city council in 2009 on how the project to proceed (City of Medicine Hat, 2008).

In December of 2010, the Alberta Utilities Commission (AUC) approved an application from the city to develop four turbines (Alberta Utilities Commission, 2010). The decision

document details an initial application in 2009 described a 10 turbine configuration across approximately six quarter sections, capable of generating 16 MW. Due to land use constraints, the number of turbines was reduced to 8, with the same 16 MW capacity (Alberta Utilities Commission, 2010). In 2010, the application was amended to reduce the number of turbines to 4 with a capacity of 8 MW. The city stated that this reduction was responding to a recommendation from Alberta Sustainable Resource Development advising that turbines cannot be closer than 500 metres from the South Saskatchewan River Breaks (Alberta Utilities Commission, 2010).

This AUC decision document also noted that the city has notified all occupants and landowners in a 2,000 metres radius of the project site. On May 1st, 2008 a public open house was held and attended by landowners, area business people, local media, and members of the general public (Alberta Utilities Commission, 2010). In considering approving the project, the AUC also notes that the project did acquire sign-off from Alberta Sustainable Resource Development and approvals from Transport Canada and NAV CANADA. The AUC provided the city with approval to proceed with development (Alberta Utilities Commission, 2010).

The wind farm as approved by the AUC was anticipated to cost $25 million dollars (City of Medicine Hat, 2011). The city started to explore options for a P3 arrangement, reaching an arrangement with WindRiver Power Corporation (Dodge and Thompson, 2016), through subsidiary Box Springs Wind Corporation (City of Medicine Hat, n.d.h).

The city officially transferred ownership of the wind farm to the Box Springs Wind Corporation on September 21, 2012 (Alberta Utilities Commission, 2012). On October 19, 2012, the city issued a development permit for 3 turbines (City of Medicine Hat, 2012a).

In 2013, the Box Springs Wind Corporation requested and was granted amendments to their AUC approval to use a different turbine technology and to develop the project in two phases: the first being three turbines to be constructed by the end of 2013, while phase 2 would comprise the fourth turbine to be erected by 2015 (Alberta Utilities Commission, 2013a). The phase 1 timeline would later be extended to October 31, 2014 (Alberta Utilities Commission, 2013b). It is unclear why the phase 2 development did not proceed. The 2013 AUC Approval Document notes that the Box Springs Wind Corporation did complete an updated Noise Impact Assessment for the new turbines and submitted an updated statement from Alberta Environment and Sustainable Resource Development stated the project updates did not result in additional concerns, as well as updated approvals for Transport Canada and NAV

Canada and confirming that consultation has occurred with the city and residents near the project site (Alberta Utilities Commission, 2013a).

The project was completed on July 25, 2014 (ClearSky Engineering Inc, 2019).

Contributing Factors

The development of the Box Springs Wind Farm was motivated by a number of factors. The city demonstrates that they are clearly interested in lowering their carbon footprint. The city website specifies that the city is interested in Green Initiatives as an opportunity to diversify the energy generation mix, protect the environment, and reduce their greenhouse gas emissions. The city also mentions that Medicine Hat is in a prime location to harness wind and solar energy, reflected in the feasibility studies before the development of the Box Springs project (City of Medicine Hat, n.d.g).

An advantage of the P3 arrangement is that the city maintains the carbon credits produced by this project, calculated by determining the amount of GHG productions required to produce the same amount of energy using conventional fossil fuel power generation (ClearSky Inc., 2019). These carbon credits can be used to offset emissions from the municipally-owned natural gas power plant (ClearSky Engineering Inc., 2019). This project was estimated to result in 93,000 tCO2e emissions reduced (ClearSky Engineering Inc., 2019).

The Box Springs Wind Corporation required the 20-year purchase agreement to borrow the money to build the $12 million dollar project. This agreement facilitated the loan from ATB Financial to the Box Springs Wind Corporation by providing price certainty for the electricity generated with Medicine Hat's AAA credit rating (Dodge and Thompson, 2016).

Leadership & Expertise

The City of Medicine Hat has a unique opportunity to develop renewable energy projects, and was able to use the city-owned utility to pursue the city's Sustainability goals. As an energy provider, the City of Medicine Hat has experience with developing energy generation projects. Expertise also came from WindRiver Power Corporation, the parent company of the Box Springs Wind Corporation, a company with experience developing wind energy projects (Management, n.d.).

Key Challenges

This project originally started with a much more significant scope, at 10 turbines. The land requirements for turbine development forced a reduction in the number of turbines (Alberta Utilities Commission, 2010). Further restrictions came from environmental regulations by the Alberta Sustainable Resource Development regarding developing near the river. From an original intention to build 10 turbines, the end project features only 3 turbines (City of Medicine Hat, n.d.h).

Achievements to Date

The Box Springs Wind Farm is still operational and the purchase agreement is in place until 2034. As of May 16, 2019, the project has generated 1,828,981 kWh (City of Medicine Hat, n,d.h.)

Links to community objectives

Medicine Hat's community objectives are outlined in the Municipal Development Plan (MDP), a document based on a 50-year vision of the city's growth and development that serves as the foundation for future statutory and non-statutory plans (City of Medicine Hat and planningAlliance, 2012). Within the Vision and Principles section of the document, Medicine Hat hopes to be a leader in alternative energy, specifically citing biomass, solar, and wind energy (City of Medicine Hat and planningAlliance, 2012). One of the principles that guide the document is provided as: "A Green and Sustainable Community", which includes a sustainable energy supply with a growing mix of renewable energy (City of Medicine Hat and planningAlliance, 2012). This project is consistent with the goals for sustainable and environmentally friendly projects.

Future Directions

The City of Medicine Hat is exploring opportunities to increase their power generation, claiming that the recently completed Unit 16 natural gas facilities as attracting new businesses to the city (Gallant, 2019). However, the city is proposing a new natural gas facility, Unit 17, adjacent to the Unit 16 power plant, to provide additional energy supply (City of Medicine Hat, n.d.i). There does not appear to be any publicly available plans to expand or alter this project before the 20-year purchase contract ends.

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Winchie Creek Hydro - Tla-o-qui-aht First Nation, British Columbia

Description of Community

The Tla-o-qui-aht First Nation is a nation with over 1200 members located on the west coast of central Vancouver Island (Tla-o-qui-aht First Nation, 2016). The traditional territory (Ha'wiih Haahoulthlee) of Tla-o-qui-aht First Nation includes what is now known as the Clayoquot UNESCO Biosphere and the Pacific Rim National Park (Indigenous Business Investment Council, n.d.; Cision, 2014). The governance structure of Tla-o-qui-aht First Nation is composed of both the hereditary chiefs (ha'wiih), and an elected chief and council (Indigenous Business Investment Council, n.d.).

The community of Opisaht, located on Meares Island

Peruzzo. (2018). Opisaht village [digital image]. Retrieved from: https://www.nationalobserver.com/2018/05/15/old-pipes-new-clean-energy-projects-nation-leading-renewable-development

Together with the thirteen other Nations, Tla-o-qui-aht First Nation is part of the Nuu-chah-nulth Tribal Council (Nuu-chah-nulth Tribal Council, 2019). These fourteen Nations span

across three regions of Vancouver Island (Nuu-chah-nulth Tribal Council, 2019). The Tla-o-qui-aht are part of the Central Region, together with the Ahousaht, Hesquiaht, Toquaht, and Yuu-cluth-aht Nations (Nuu-chah-nulth Tribal Council, 2019).

The history of the Tla-o-qui-aht First Nation has undoubtedly informed the current pursuit of run of river hydroelectric development. Together with the thirteen other Nuu-chah-nulth Nations, the Tla-o-qui-aht resisted the forestry company MacMillan Bloedel Ltd. in its attempts to pursue logging on Meares Island (Gilpin, 2018). Following a 1984 protest in the provincial capital, the Nation declared Nuu-chah-nulth ownership of the land (Gilpin, 2018). In the 1993 Clayquot Protests, the community, together with other First Nations and environmental groups, protected a large portion of old growth forest from clear-cutting by MacMillan Bloedel Ltd. over a period of five months (Gilpin, 2018). Their involvement in environmental protection movements has set the stage for Tla-o-qui-aht to pursue economic development opportunities that protect their territory and ecosystem.

Description of Project

Beginning operations in July 2018, the Winchie Creek hydroelectric project is a micro-hydro project located within the Tla-o-qui-aht First Nation's ancestral territory (Ha'wiih Haahoulthlee) (Water Power Magazine, 2015; Barkley Project Group, 2018). Located 35 km east of Ucluelet, this run of river project has a capacity of 4.1MW (Barkley Project Group, 2018). Run of river infrastructure uses the elevation and natural flow of a stream to create power (Array, 2014). The water travels through a pipe until it reaches the turbine, which spins to create electricity, before it rejoins the river (Array, 2014). The company Mavel Americas supplied the generator, inlet valve, hydraulic power unit, as well as the 5-jet Vertical Pelton turbine that powers the project (Water Power

Winchie Creek Hydro

Barkley Project Group. (n.d.a.). Winchie Creek Hydro [digital image]. Retrieved from: https://barkley.ca/portfolio-item/winchie-creek-hydro/

Magazine, 2015). This project is EcoLogo certified, as it has been designed to have minimal footprint on fish habitat and the surrounding environment (Barkley Project Group, n.d.). The project is located above a waterfall, which creates a barrier that protects salmon and other anadromous fish from the project intake when migrating upstream (Plummer, 2018; Water Power Magazine, 2015). The water that leaves the turbine also remains free of contaminants, preserving the state of Tla-o-qui-aht First Nation's fisheries (Plummer, 2018).

Winchie Creek is the third hydroelectric project undertaken by Tla-o-qui-aht First Nation, following the China Creek and Haa-ak-suuk projects (Array, 2014). The combined capacity of these three stations will generate enough electricity to power 5,500 homes in surrounding communities, such as Tofino, Ucluelet, and Port Alberni (Plummer, 2018). Unlike the first two projects which have mixed ownership structures, Winchie Creek is one hundred percent owned by Tla-o-qui-aht First Nation and is managed by the Nanaimo-based Barkley Project Group (Barkley Project Group, n.d.; Indigenous Business Investment Council, n.d.). The project will generate electricity for sale to BC Hydro under a forty-year agreement (Barkley Project Group, n.d.).

The project received $554,487 in funding from the federal government under the then Aboriginal Affairs and Northern Development Canada's Community Opportunity Readiness Program (CORP), an initiative the provides financial support to First Nation and Inuit communities pursuing economic development opportunities (Cision, 2014). Additional financial support for Winchie Creek was provided by Nuu-chah-nulth Economic Development Corporation and the Province of British Columbia, including the Western Diversification Program, British Columbia Indigenous Clean Energy Initiative (BCICEI), BC Rural Dividend Program and the First Nations Clean Energy Business Fund (Tla-o-qui-aht First Nation, 2018). The financial advisory company Stonebridge Financial Corporation acted as a Financial Arranger for the Winchie Creek project, and announced the closure of $14 million, 39.5 year fixed rate debt financing in October 2018 (Stonebridge Financial Corporation, 2018).

Contributing Factors

The primary driver behind the development of Winchie Creek was the precedent of run of river projects initiated by Tla-o-qui-aht First Nation and other First Nations on Vancouver Island, including China Creek, Canoe Creek, and Haa-ak-suuk Creek. Winchie Creek is also one such example of the emerging small scale run of river hydro in British Columbia as a renewable alternative to diesel fuel and conventional storage hydro (Indigenous Business Investment Council, n.d.; Cision, 2014).

Canoe Creek Hydro

Ha-Shilth-Sa. (2018). A pen stock carries water down a mountain to the Canoe Creek Hydro powerhouse [digital image]. Retrieved from: https://hashilthsa.com/news/2018-05-01/micro-or-macro-hydro-nuu-chah-nulth-nations-push-regional-power-generation-province

The region is also well positioned for the development of run of river hydro, as the Winchie Creek watershed receives 4000 mm of rainfall annually (Water Power Magazine, 2015). The development of run of river facilities on Vancouver Island also has great potential for providing power to a region that currently imports 70% of its electricity from mainland British Columbia (Tla-o-qui-aht First Nation, 2018).

Leadership and Expertise

As the third run of river hydro project for Tla-o-qui-aht First Nation, Winchie Creek has received widespread support. The project is supported by Tla-o-qui-aht First Nation's Economic Development Corporation (MLP) (Tla-o-qui-aht First Nation, 2018). The Nation's economic strategy has been in place since 2007, with a mandate of investing in renewable energy that is sustainable, environmentally sound, provides a return on investment, and is owned and controlled by the Nation (Tla-o-qui-aht First Nation, 2016).

Significant project proponents representing the Nation include Saya Masso, the Nation's natural resource manager, and the Economic Development Officer, Jamie Bassett, a mechanical engineer and business development consultant who has been assisting the Nation's Development Corporation in its pursuit of micro-hydro projects since 2005 (Clean Energy BC, n.d.; Tla-o-qui-aht First Nation, 2016).

Powerhouse at Winchie Creek Hydro

Barkley Project Group. (n.d.b.). Winchie Creek Hydro [digital image]. Retrieved from: https://barkley.ca/portfolio-item/winchie-creek-hydro/

The Nanaimo-based Barkley Project Group also played a significant role in the development of this project and have maintained a productive working relationship with Tla-o-qui-aht First Nation in the development of their renewable energy portfolio over the last sixteen years (Barkley Project Group, 2018). The project also relied on local contractors and suppliers, including Roc-Star Enterprises and Athecon Projects of Port Alberni, Prime Engineering of Victoria, and Westpark Electric of Chilliwack (Tla-o-qui-aht First Nation, 2018).

Key Challenges

Tla-o-qui-aht First Nation experienced challenges in the development of their first two run of river projects. The Canoe Creek project faced difficulties in raising capital during the 2008 economic downturn (Indigenous Business Investment Council, n.d.). The Haa-ak-suuk project had issues with the delivery of the pipes, a $2.5 million component of the project (Indigenous Business Investment Council, n.d.). With the ultimate success of Canoe Creek and Haa-ak-suuk, the Nation has established a track record as an experienced party in the area of run of river hydro, and challenges such as these were not identified during the development of the Winchie Creek project.

The challenges associated with the development of the Winchie Creek project are embedded in larger concerns around the perception of First Nation-owned micro-hydro projects in a provincial context dominated by large scale hydroelectric development. The

approval of the Site C large scale dam project from the provincial NDP and Premier John Horgan is of particular concern for First Nations involved in micro-hydro initiatives. The position of BC Hydro is one forecasting a power deficit if the Site C project is not built (Plummer, 2018). They anticipate an increase in electricity needs by 40% over the next twenty years, driven by population influx of more than one million residents, economic development, a growing liquefied natural gas sector, and an increase in electric vehicle use (Plummer, 2018). This necessitates the development of the project on the Peace River covering 9,330 hectares for a capacity of 1,100 megawatts and costing upwards of $9 billion (Plummer, 2018). BC Hydro has also critiqued run of river hydro as a cost ineffective alternative to the Site C project, as it is perceived to be unreliable during times of peak demand (Plummer, 2018).

The position of First Nation-owned run of river hydro advocates, including President of the Nuu-chah-nulth Tribal Council Judith Sayers, and Tla-o-qui-aht First Nation's natural resource manager Saya Masso, is that the development of Site C will result in an energy surplus for the province (Plummer, 2018; Cox, 2018). With this anticipated influx of energy, BC Hydro has been less receptive to investing in clean energy projects (Cox, 2018). This has raised concerns around the increasing competition for BC Hydro's purchase agreements among the growing number of First Nation's pursuing run of river hydro (Plummer, 2018). In a February 2019 announcement, BC Hydro's Standing Offer Program, an initiative designed to encourage the development of small clean or renewable electricity projects throughout the province, was suspended indefinitely, citing that "a number of measures to lower our costs to keep rates low are being implemented, including reducing the amount of future energy purchases from independent power producers" (BC Hydro, 2019).

BC Hydro has been critiqued for a lack of engagement with those First Nations that produce power in the province before proceeding with the construction of Site C (Cox, 2018). As of 2018, approximately 125 of the 203 First Nations in British Columbia are involved in clean energy projects in some capacity (Cox, 2018). The B.C. First Nations Clean Energy Working Group, representing 78 Nations across the province, was unsuccessful in its attempts to meet and discuss potential of First Nation-led solar, wind, and run of river projects with the provincial Minister of Energy, Mines and Petroleum Resources, Michelle Mungall, prior to the government's December decision to proceed with construction of the project (Cox, 2018). Members of the Working Group, including fourteen chiefs, were granted a meeting with Minister in March 2018 to discuss their goals for clean energy development, although no follow up has taken place (Cox, 2018).

Achievements to Date

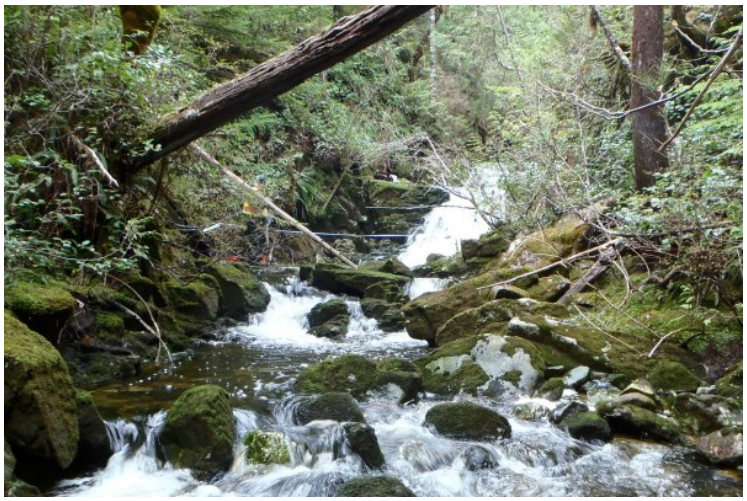
The Winchie Creek hydroelectric project represents a landmark case of First Nation-owned energy in British Columbia. The Tla-o-qui-aht are the first Nation to hold such as high ownership stake on a hydroelectric project on Vancouver Island, and this project is the first run of river hydro facility wholly owned by the Tla-o-qui-aht First Nation (Gilpin, 2018; Barkley Project Group, 2018). Estimates projected that approximately 187 direct and indirect jobs were created in the region throughout the construction process (Cision, 2014). The project also represents a promising revenue stream, providing an alternative to a proposal from Imperial Metals to explore gold mining in the Nation's territory (Plummer, 2018).

Links to Community Objectives

The Tla-o-qui-aht First Nation's portfolio of run of river hydro projects is well aligned with the Nation's Economic Development business plan, and a mandate to pursue economic development with a focus on renewable energy development (Array, 2014). The Nation is committed to working towards a balanced and diversified economy, with the ultimate goal of reach energy self-sustainability (Array, 2014). The ownership of this project had been an important factor for the Nation, as the benefits will stay within the community (Plummer, 2018). The revenue generated from the project has been used to fund essential programs and services for community members, such as campgrounds, trail building programs, environmental monitoring and restoration, and to ensure economically and environmentally sustainable livelihoods for the Nation (Plummer, 2018, Tla-o-qui-aht First Nation, 2018). The revenue has also supported the Nation's tribal park program, and the Nation has since declared the entirety of its territory, including Meares Island and Ha'uukmin (Kennedy Lake), a tribal park (Gilpin, 2018). Through the Tla-o-qui-aht Tribal Parks Program, the Nation is working to restore Coho salmon habitat, and implement changes to land use practices (Gilpin, 2018).

The area within the territory of the Tla-o-qui-aht First Nation now known as Tofino has not always been a benefit to the Nation and the surrounding ecosystem (Gilpin, 2018). The growing tourism sector attracts around one million visitors annually (Gilpin, 2018). This has had

damaging effects on the Nation, including the closure of clam beds due to excessive sewage, and noise pollution from airplanes (Gilpin, 2018). The Nation is in the process of negotiating an ecosystem service fee with the Tofino-Long Beach Chamber of Commerce, a discussion that has been ongoing since 2008 (Gilpin, 2018). The fee would be paid to those parties involved in preserving the local ecosystem, including encouraging sustainable land-use practices, recovering forested areas, and restoring habitats (Gilpin, 2018). The revenue stream from Winchie Creek and other run of river projects provide a valuable contribution to these initiatives.



Ahtaapq Creek Hydro Proposed Site

Barkley Project Group. (n.d.c.). Ahtaapq Creek Hydro [digital image]. Retrieved from: https://barkley.ca/projects/

Future Directions

The Tla-o-qui-aht First Nation has completed feasibility studies for four additional run of river hydro projects within the territory in the Tofino and Tranquil watersheds (Cox, 2018; Plummer, 2018). The Nation's endeavours are part of emerging efforts in renewable energy among remote British Columbia communities, 175 of which are currently off-grid and reliant on diesel shipments (Plummer, 2018). The Barkley Project Group are currently involved in two run of river hydro projects that will service these communities (Plummer, 2018). The Huu-ay-aht First Nation has been involved in environmental assessments and community consultations to develop a five-megawatt project on the Sarita River (Plummer, 2018). Access roads to the site have been completed, and the facility is anticipated to be operational within two years (Plummer, 2018). This project would supply the Huu-ay-aht village of Anacla as well as Bamfield, which have experienced outages due to storm damage to the power line from Port Alberni (Plummer, 2018).

The Hesquiaht First Nation, located north of Tofino in Hot Springs Cove, is also working with the Barkley Project Group to develop a 250-kilowatt run of river facility on Ahtaapq Creek (Plummer, 2018). This off-grid community is currently reliant on shipments of diesel to power

generators for its fifty residents (Plummer, 2018). The access road to the project site is currently in construction, and the most recent update from the Barkley Project Group is that the project itself is currently in the detailed design phase (Barkley Project Group, 2017; Plummer, 2018).

With the suspension of BC Hydro's Standing Offer Program, the future of these projects and the subsequent purchase agreements with BC Hydro is unclear. The most recent media coverage of Huu-ay-aht First Nation's Sarita River project and Hesquiaht First Nation's Ahtaapq Creek project is from the summer of 2018. Representatives from the Tla-o-qui-aht First Nation have also expressed dismay that the four projects in progress within their territory will be affected by the suspension of the Standing Offer Program (Cox, 2019). Although the $10 million Ahtaapq Creek project is receiving funding from the federal government as part of an initiative specifically targeting off grid communities currently reliant on diesel, the status of these projects remains uncertain at this time (Plummer, 2018).

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Regina Landfill Gas to Energy Project – Regina, Saskatchewan

Description of the Community

Regina, the capital city of Saskatchewan, is located in the south central area of the province, in the middle of the Prairies (City of Regina, n.d.). In 2016, Regina recorded a population of 214,631 people, a 11.7% increase since 2011 (Statistics Canada, 2017). Regina is a relatively affluent community, with a median household income of $81,850 compared to the

provincial average of $75,412 in 2015 and a relatively young population, with a median age of 36.6 compared to the provincial median of 37.8 in 2016 (Statistics Canada, 2017).

The economy of Regina is driven by a number of key sectors, including manufacturing, metal fabrication, value-added agriculture, mining, tourism, finance and insurance, and oil and gas supply chain (Economic Development Regina Inc., n.d.a.). Further details on Regina's major economic drivers are provided in the table below (Table 1). Regina experienced substantial economic growth from 2010 to 2014, but saw negative GDP growth in 2015 and 2016. Post-2017, the Conference Board of Canada projects modest economic growth, relatively close to the projections of economic growth for Saskatchewan and Canada (Wiebe, 2017).

Table 1. Major economic drivers in Regina, Saskatchewan (2018).

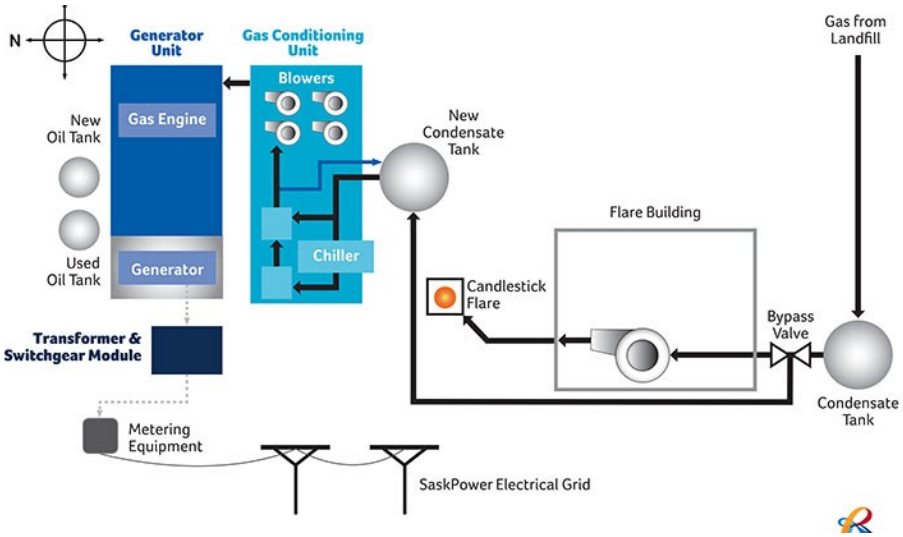
	Number of Employees	GDP	% of GDP
Manufacturing	6,013	$886 million	5.9%
Metal Fabrication	837	$81.8 million	0.5%
Value Added Agriculture	2,271	$304.3 million	2.0%
Tourism	8,322	Not available	2.1%
Mining Supply Chain	4,597	$2 billion	13.3%
Finance & Insurance	7,566	$2.1 billion	14.2%
Oil & Gas Supply Chain	3,377	$1.14 billion	7.6%

*Sources: Economic Development Regina Inc., n.d.b., n.d.c., n.d.d., n.d.e., n.d.f., n.d.g., n.d.h

Description of the Project

In 2017, the City of Regina announced the completion of the Regina Landfill Gas to Energy project, located at the City of Regina Landfill (Baird, 2017). This facility captures methane gas produced by the landfill and uses it to produce renewable electricity. With a capacity of 1 MW, the project is anticipated to reduce greenhouse gas emissions by 30,000 tonnes annually (CBC News, 2017). The facility is operated through a Power Purchase Agreement with SaskPower, the provincial energy utility, and was administered under the Green Options Partners Program (City of Regina, 2014d). As per this agreement, the city receives a fixed price of $106.1 / MWh generated in 2014 and rising 2% a year (City of Regina, 2014d). The City predicts the project will generate $21 million dollars within the 20 year duration of the Power Purchase Agreement (CTV Regina, 2014). With an operating cost of $44 / MWh and a capital cost of $5 million, the City anticipates the facility to generate $7.1 million in

surplus of cost in the 20 year timeline (City of Regina, 2014d), with a recovery of the capital investment within 8.5 years (City of Regina, 2014a).



Regina Landfill Gas Energy Project

Waste Today Staff (2017). Canadian City Unveils Landfill-Gas-to-Energy Facility [digital image]. Retrieved from: https://www.wastetodaymagazine.com/article/waste-to-energy-regina-saskatchewan/

The initial $5 million capital cost was funded through the Solid Waste Reserve (City of Regina, 2014b), a fund used to pay for capital expenditures for Landfill Operations, Solid Waste Collection, and Waste Diversion Services Branches (City of Regina, 2014c).

Project Development Timeline

The Regina Landfill site has had a methane capture system since 2008, consisting of 27 extraction wells (Baird, 2017). The methane captured was destroyed using a flare (Genivar Consulting LP, 2009).

An environmental impact assessment conducted for the landfill expansion in 2009 notes an agreement with a third-party corporation, Solar Hydrogen Energy Corporation (SHEC), to utilize the landfill gas collected as a fuel source, although the project was not operational (AMEC Earth & Environmental, 2009). However, SHEC failed to meet their contractual obligations and this agreement was terminated (CBC News, 2010 and City of Regina, 2014d).

In April 2014, Regina's Public Works and Infrastructure Committee heard the recommendation to develop the Landfill Gas to Energy Facility, which was approved and sent for City Council approval (City of Regina, 2014d). City Council passed the motion and a Request for Proposal (RFP) was issued that month, seeking an engineering firm with landfill gas experience to assist in the pre-design, design, and construction of the project. The project

would be awarded to Golder Associates Ltd. (Engineering Services for Landfill Gas and Energy Project -- COR2357, 2014).

In 2017, the project began operation, running for 4,217 hours, producing 4,313.06 MWh, and generating a gross revenue of $393,000 (City of Regina, 2017b).

Contributing Factors

Motivations for the development of this project are best captured in the original report prepared for council in 2014. This report includes a triple bottom line assessment, or an analysis of the project from an environmental, social, and economic perspective.

The environmental impacts of the project are beneficial, as the project prevents the emissions of methane, a problematic greenhouse gas. The report also notes that the landfill gas produced can sustain the facility beyond the duration of the 20-year timeline (Baird, 2017). This motivation was displayed in quotes by Mayor Michael Fougere, who said: “This project has been a major advancement in protecting our environment” (SWR Staff, 2019), Lisa Legault, Director of Solid Waste, who said: “We are excited that the City of Regina has taken steps to reduce the greenhouse gases.” (Baird, 2017), and Howard Matthews, Vice-President of Power Production with SaskPower, who said: “This is a sustainable future for us” (Baird, 2017).

The Council Report also notes social benefits from this project. The prior methane destruction method, flaring the gas, was perceived by the public as polluting (City of Regina, 2014a). Public consultation revealed that the public supports the production of energy from “garbage” and that the City will be perceived as an “environmentally-conscious organization by its continuous commitment to voluntarily reduce greenhouse gas emissions” (City of Regina, 2014d). Mayor Michael Fougere echoes this sentiment in this statement: “this is the kind of innovation and project that we want to have a commitment for” (Baird, 2017). A report to council specifically notes that the City of Saskatoon received significant media attention after commissioning the development of a green energy park and a landfill gas co-powered generation plant (City of Regina. 2014a).

The final consideration in the triple bottom line assessment is a financial assessment (City of Regina, 2014a). The report to council specifically mentions the $7.6 million surplus over costs over 20 years and that the project will continue to earn emission reduction credits, which may provide another source of revenue (City of Regina, 2014d). This motivation is evident in a statement made by the Director of Solid Waste Lisa Legault: “We are excited that the City of Regina has taken steps to reduce the greenhouse gases and to find another source of revenue

other than property taxes" (Baird, 2017). A brief conversation with a representative of the City of Regina also emphasised the importance of pursuing non-tax revenue generation (Personal communication, April 16, 2019). A key consideration in the economic analysis is the financial security provided by SaskPower, which provided guaranteed and preferential rates through the Green Options Partners Program (City of Regina, 2014a). According to a City of Regina representative, this project would likely not have gone forward without a contract in place (Personal communication, April 16, 2019).

Media and reports reviewed do not highlight one single dominant motivation, and it appears considerations in all three of these dimensions encouraged the development of this project.

Leadership and Expertise

This project required demonstrated leadership by the City of Regina administration and council, who proposed and approved the project. Technical expertise required the assistance of a qualified landfill gas to energy engineering consulting firm to assist in designing and implementing the power generating system and grid connection consistent with legal requirements and international best practices (Engineering Services for Landfill Gas to Energy Project -- COR2357, 2014). Through the RFP process, the City enlisted the assistance of Golder Associates Ltd. (Engineering Services for Landfill Gas to Energy Project -- COR2357, 2014).

Development of the project also required the assistance of SaskPower, who provided a fixed and preferential price (City of Regina, 2014d) that provided the financial security that encouraged development.

Key Challenges

This project was challenged by the loss of a private industry partner early in development. In 2007, the City of Regina discussed the possibility of selling landfill gas to the Solar Hydrogen Energy Corporation Ltd., who intended to build a solar-powered facility to turn the landfill gas into hydrogen gas (Rhodes, 2007). In 2010, the City of Regina terminated the agreement, after supplying landfill gas to the SHEC but receiving no payment (CBC News, 2010 and City of Regina, 2014d). The President and CEO of SHEC claimed an unforeseen economic crisis caused a downward trend in the price of natural gas, making the project uneconomic (CBC News, 2010). City administration recommended the termination of the agreement but continued to note the economic feasibility of landfill gas utilization (CBC News, 2010).

Partnering with a private corporation was again considered in 2014, but the City did not consider the option due to the presence of in-house expertise, increased revenue from ownership, the presence of capital for investment in the Solid Waste Reserve, and a time constraint to execute the power purchase agreement by a specific date (City of Regina, 2014d).

Another challenge came in the suspension of the Green Options Power Program while the project was still in development. However, SaskPower upheld the agreement, resulting in the financial conditions necessary for project approval (City of Regina, 2014d).

Achievements to Date

The project became operational in 2017, where it ran for 4,217 hours and produced 4,323.06 MWh of energy and generated a gross revenue of $393,000 (City of Regina, 2017b). In a statement in 2019, Mayor Fougere said the city currently receives $1 million from the Landfill Gas to Energy project (CBC News, 2019).

Links to Community Objectives

This project aligns with several objectives outlined by the community. As per the Official Community Plan of Regina, which outlines long-term strategic goals, the project is consistent with Policy 6.12: “Explore waste-to-energy processes whereby waste and waste byproducts of one activity are used as resources for another” (City of Regina, 2017a and City of Regina, 2013). This policy falls within the goal of promoting conservation, stewardship, and environmental sustainability (City of Regina, 2013). As stated by Mayor Fougere: “This project demonstrates our commitment to reducing greenhouse gas emissions and seeking partnerships with organizations who are also committed to environmentally responsible action.” (Waste Today Staff, 2017).

The Landfill Gas to Energy Project also contributes to the Official Community Plan goal “Achieve long-term financial viability”, by generating revenue for the community (City of Regina, 2013). The project is also in line with Regina’s strategic direction to manage growth, as it generates revenue from a non-residential tax source (City of Regina, 2014d).

This project also contributed to SaskPower’s goal of generating 50% of its energy from renewable sources (Baird, 2017). SaskPower announced this goal in 2015, as part of an effort to reduce emissions by 40% below 2005 levels by 2030 (SaskPower, 2017).

Future Directions

The Power Purchase Agreement for the project provides a 20 year timeframe for the operation of the facility at the agreed upon rate of energy purchase. After this period, the City has the opportunity to enter into negotiation with SaskPower for the continued sale of energy or to use the energy internally (City of Regina, 2014d). Vice President of Power Production at SaskPower Howard Matthews also notes that there is enough capacity to develop a second generator, if the project proves to be successful (Braid, 2017). In 2019, the City announced a project to drill 30 additional wells to capture more landfill gas, funded with a $1.3 million dollar investment from the federal government through the Low Carbon Economy Fund (CBC News, 2019). A representative of the City of Regina did state that this expanded capture plan did not include an expansion to the gas to power facility and that the additional methane would be flared. However, they did note that the facility was built with the opportunity to add a second generator, increasing capacity (Personal communication, April 16, 2019). Like the initial project, this expansion would likely also require a Power Purchase Agreement to provide financial security before the City moves forward (Personal communication, April 16, 2019). The Green Options Partners Program that the original power purchase agreement was part of is no longer available.

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Canoe Reach Geothermal Project – Valemount, British Columbia

Description of Community

The Village of Valemount, British Columbia is situated in the Robson Valley in British Columbia's North Thompson Region (Tourism Valemount, n.d.). The self-described quaint mountain village is a gateway to various outdoor activities, due to its proximity to the Cariboo, Monashee and Rocky Mountains, including Mount Robson Provincial Park, Berg Lake, and the Fraser River (Tourism Valemount, n.d). The Village's location is also relatively remote. It is the final stop on the hydro line as well as the shipping route from Kamloops, making it no stranger to empty produce shelves and power outages (Ward, 2019). This has fueled the resourceful and resilient spirit of the community of 1,021 residents (Statistics Canada, 2016).

Valemount, British Columbia

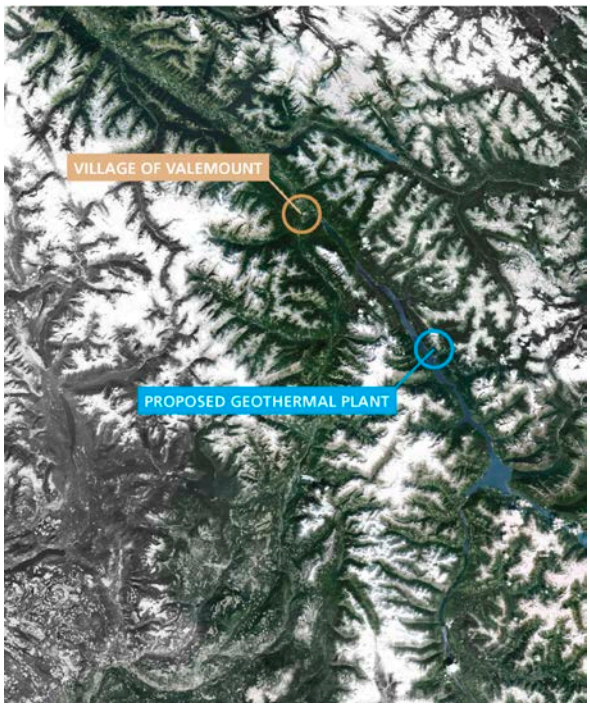
Northern Development Initiative Trust. (n.d.). Village of Valemount [digital image]. Retrieved from: https://www.northerndevelopment.bc.ca/explore-our-region/success-stories/valemount-welcoming-investment-to-improved-downtown/

The Village has its history in a thriving forestry industry. At its peak in the mid 1990s, the lumber mill and companion logging industry employed approximately 20% of the 1400 residents (McCracken, 2015). Following the closure of the mill in 2006, the community worked to develop the tourism industry as its main economic driver (McCracken, 2018). Initially contested as a substitute for the highly paid, skilled jobs of the forestry industry, tourism has thrived in Valemount, attracting young entrepreneurs and families to the region seeking a high quality of life in a mountain landscape (McCracken, 2018). The region offers opportunities for mountain biking trails, backcountry skiing and snowmobiling (McCracken, 2018). The Village continues to pursue opportunities for economic diversification, such as the establishment of the Valemount Community Forest on the old mill site, covering an area of 70,182 hectares (BCCFA, n.d.). This organization aims to provide opportunities for small to medium size

enterprises such as wood manufacturing facilities, fibre-based industry, sort yards, re-load yards, greenhouses, and geothermal development (McCracken, 2015; Marshall, 2014).

Description of Project

The Canoe Reach Geothermal project was initiated with the objective of transforming the Village of Valemount "by providing locally grown food using geothermal greenhouses, micro-power for commercial uses, and heat for eco-tourism attractions such as hot pools, all with a minimal carbon footprint" (McCracken, 2018). After initial visits to Valemount in 2010, Calgary-based Borealis GeoPower expressed interest in geothermal electricity generation, as well as a partnership that would make use of the surplus geothermal heat (Personal communication, June 2, 2019). Together, the municipality, the community forest, and the Canadian Geothermal Energy Association held a two-day workshop that catalyzed public support for the potential uses for geothermal heat (Personal communication, June 2, 2019). Located fifteen kilometres south of the Village, the proposed site of the Canoe Reach Geothermal project has now undergone an extensive pre-feasibility study and geophysical surveys including magnetotelluric, gravity and seismic surveys (Borealis GeoPower, 2017). Based on this exploratory work, subsurface temperatures at a depth of around 1000 metres are estimated at 200 degrees Celsius (Borealis GeoPower, 2017). This translates into a potential 11,200 petajoules of thermal energy, which at 15 degrees Celsius has a capacity to generate 58 MW of power over the course of thirty years (Borealis GeoPower, 2017). Based on these preliminary findings, this proposed development is considered an "inferred geothermal resource" in accordance with the Canadian Geothermal Energy Association's Canadian Geothermal Code for Public Reporting (Borealis GeoPower, 2017). As of 2017, the drilling plan involves five temperature gradient holes to depths between



Project proximity to Valemount

MMM Group. (2012). Proposed Geothermal Plant Location [digital image]. Retrieved from: http://www.valemount.ca/sites/default/files/docs/EDO/MMM%20Summary%20Report%201.pdf

200 and 1000 metres (Borealis GeoPower, 2017). The project will be carried out in three phases, starting with hot springs, a project initiated by Valemount Geothermal Society (Bennett, 2017). The second phase of Canoe Reach is set to be a 1 MW power facility (Bennett, 2017). This capacity will generate enough electricity to fulfill the energy needs to Valemount's 1100 residents (Bennett, 2017). Phase three would develop a larger, 15 MW power plant (Bennett, 2017). The development plan for the Canoe Reach Geothermal Project also includes Borealis GeoPower's Sustainaville demonstration project, a "commercial Geo-Park" including a brewery, greenhouse, fish farm, and biomass facility powered and heated by geothermal energy (Borealis, 2017). In a 2017 report Borealis announced that a request for budget quotes for the GeoPark has been released to a select list of international vendors (Borealis GeoPower 2017).

As the project is currently in development, the ownership structure remains unclear at this time. However, a community ownership stake has been an important aspect since the inception of this project. In personal communication with a community member, they shared that assurance that any project benefits or profits are kept within the community to support the local economy is a vital part of this project (Personal communication, June 2, 2019). An ownership stake would ensure that community members have a degree of influence throughout project development, maintaining the mandate of sustainable community growth in a way that preserves the ethos and values of the community (Personal communication, June 2, 2019)

Contributing Factors & Timeline

Pursuit of Canoe Reach has been motivated by a variety of factors. The Village's remote location at the end of a power line has resulted in frequent power outages (Personal communication, June 2, 2019). This unreliable electricity supply was particularly concerning when the 2003 McLure fire, over 250km from Valemount, resulted in a power outage lasting two weeks (Personal communication, June 2, 2019). The current transmission line infrastructure has also placed limitations on the extent to which the community can grow. A costly upgrade would be required in order for Valemount to have stable and sufficient power to further develop the community (Personal communication, June 2, 2019). Due to higher cost electricity and propane, and a lack of access to natural gas, residents of Valemount primarily use wood to heat their homes (Personal communication, June 2, 2019). The poor air quality associated with wood smoke makes low emission, low cost geothermal energy an appealing alternative (Personal communication, June 2, 2019).

The factors contributing to the inception of the Canoe Reach Geothermal Project plan have included involvement of a variety of stakeholders since Borealis GeoPower Inc. acquired geothermal tenure in the Valemount area in 2010 (McCue, 2018). In 2011, Borealis entered into a Memorandum of Understanding with the Shuswap, the Skwlax, and the Simpcw First Nations on the development and construction of the proposed project (Richter, 2011). Continued engagement with the Simpcw First Nation has been identified as a priority moving forward with the project (Marshall, 2017). The First Nation has established Simpcw Resources Group Ltd., and is actively involved in environmental monitoring and management, training and skills development, and economic development and partnerships with companies in the North Thompson region (Simpcw First Nation, n.d.).

In April 2012, the Village of Valemount hired MMM Group, now acquired by Canadian consultancy WSP, to conduct a pre-feasibility study "examining the economic development opportunities arising from the use of attractively priced renewable heat as well as the potential governance models and costs associated with a District Energy System (DES) in an area south of the Village in the vicinity of the geothermal electricity generating plant proposed by Borealis GeoPower" (MMM Group, 2012).

In 2016, conversations began around Valemount Community Forest developing a new Industrial Park in the region. Speakers at a community workshop included CanGEA and Borealis GeoPower, and local residents responded well to the development of geothermal energy in the form of hot springs, a direct use geopark, and electricity generation (Marshall, 2017). This led to the incorporation of the Valemount Geothermal Society, a non-profit community group advocating for geothermal energy development as a means for a reliable, renewable energy source, with the potential to improve the local economy and local food security (Marshalll, 2017). A Direct Heat Use Committee was also established by the Village of Valemount Council to focus on direct geothermal heat uses at the Valemount Community Forestry Industrial Park, adjacent to the proposed GeoPark (Marshall, 2017).

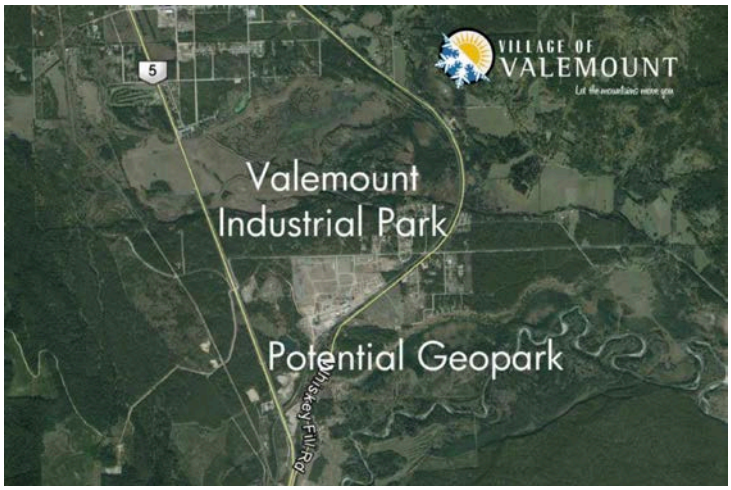
In 2018, Natural Resources Canada purchased three Climeon modules from the Swedish energy company, Climeon, for a purchase price of $1,541,000 CAD (McCracken, 2018). The purchase was supported by Natural Resource Canada's Energy Innovation Program (McCracken, 2018). These three power generation modules will produce 150 kW per unit and will be installed to create Canada's first geothermal power plant (McCracken, 2018). These highly adaptive and innovative modules can generate power from temperatures as low as 70 degrees Celsius and can be configured to account for variations in temperature over time. Additionally, these modules are interchangeable and mobile, making it easy to add additional units or move

the configuration to a more favourable location (McCracken, 2018). The company's founder Thomas Öström has said that although a geothermal power plant is a large undertaking, the portable nature of these modules, as opposed to more permanent infrastructure, has great potential to mitigate risk if something were to go wrong (McCracken, 2018).

On May 29, 2018, the British Columbia Oil and Gas Commission, the provincial authority on all geothermal resource wells or facilities since 2017, issued a geothermal resource well authorization to Borealis GeoPower Inc. for four thermal gradient wells at the Canoe Reach Geothermal Project site (BCOGC, 2018). This landmark action represents the first time the British Columbia Oil and Gas Commission has issued a well authorization under the new Geothermal Resource Act (BCOGC, 2018).

Leadership & Expertise

In addition to support from Climeon, the project has relied on leadership and expertise from a variety of stakeholders. The primary proponent of the project is Borealis GeoPower Inc. The Calgary-based company is a certified B Corporation, meeting "rigorous standards of social and environmental performance, accountability, and transparency" (Borealis GeoPower, n.d.) Borealis was the first Alberta-based company to be a part of the International Energy Agency and Clean Energy Ministerial's Equal by 30 initiative, joining a cohort of companies committed to ensuring gender equity in the renewable energy sector and closing the gender pay gap by 2030 (Borealis GeoPower, n.d.).



Proposed GeoPark Site

Marshall, K. (2017). Valemount, B.C.: Canada's next 'Geothermal Village' [digital image]. Retrieved from: http://valemountgeothermal.org/wp-content/uploads/2017/03/Canadas-Next-Geothermal-Village.pdf

Representing the community members of Valemount, the Valemount Geothermal Society was formed in 2016 to advocate for the development of the geothermal resource in the region. Korie Marshall is listed as the President of the Valemount Geothermal Society, and as of 2017, the Society had an additional forty paid staff members (Marshall, 2017).

Prepared in accordance with the Canadian Geothermal Energy Association's (CanGEA) Code, the pre-feasibility report, including an estimate of the geothermal resource in the region, was developed by the Dewhurst Group, LLC (Borealis GeoPower, 2017). The founder of the Dewhurst Group, Warren T. Dewhurst, is listed as a Qualified Person under the Canadian Geothermal Energy Association (CanGea), and a member of the Boards of Directors of both the Geothermal Resources Council and the Geothermal Energy Association (Borealis GeoPower, 2017).

The development of this project has also been supported by Natural Resources Canada. Natural Resources Canada Communications Officer Catherine Leroux has identified that the project will serve as a demonstration site to highlight the potential for geothermal exploration in other Canadian communities, with key outcomes including "proving the viability of a geothermal reservoir through optimized geothermal exploration techniques, drilling and well testing, as well as conducting a grid connection and power plant certification" (McCracken, 2018). Leroux has also stated that the federal government's position on this project is well aligned with larger efforts towards sustainable economic growth and a transition to a low-carbon economy (McCracken, 2018).

Key Challenges

Despite the support from community advocates, there has been some criticism from locals in Valemount that the Climeon modules were ordered in advance of any drilling in the region (McCracken, 2018). This hesitation is warranted due to the precedent of geothermal development in British Columbia. Following the identification of geothermal potential, developers invested upwards of $25 million to drill at the Mount Meager site (Bennett, 2017). However, the results indicated that there were not adequate flows of steam or water to generate electricity (Bennett, 2017). BC Hydro's position on geothermal development in the region has undoubtedly been shaped by the high-risk nature of such projects (Bennett, 2017). Financial barriers are also characteristic of geothermal projects with costs running between $4 million to $10 million to drill a single geothermal well, often with no guarantee of adequate subsurface temperatures (Bennett, 2017).

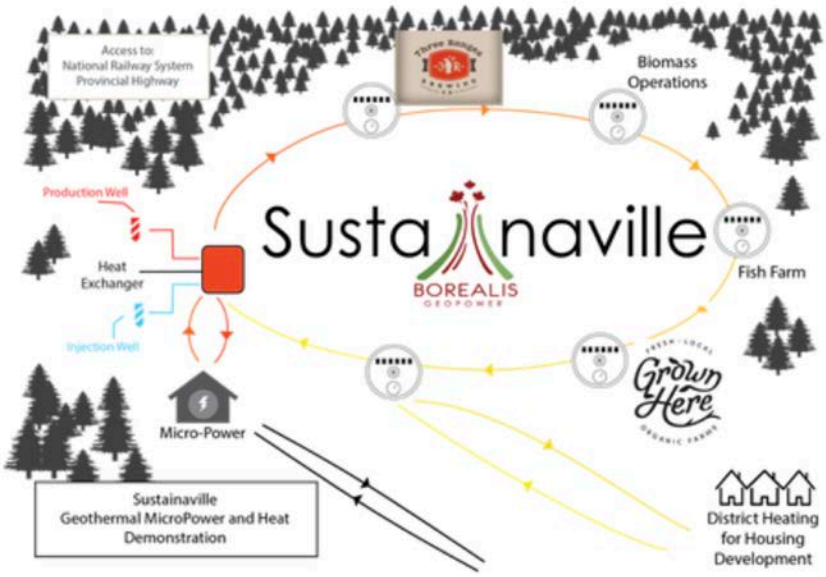
Achievements to Date

The Canoe Reach Geothermal Project is a landmark case. In addition to the project receiving the first provincial well authorization under the Geothermal Resource Act, the proposed project represents one of only three geothermal permits currently active in the

province, including the Lakelse Lake site near Terrace, and the Mount Meager site near Pemberton (BCOGC, 2018; Ward, 2018). The Canoe Reach site is poised to be one of the first large scale geothermal facilities in Canada.

Links to community objectives

In this remote Village, the sense of community identity has evolved as the economic drivers of the community have shifted from the forestry to the tourism sector. The development of geothermal energy in the region has the potential to establish the community of Valemount as an innovator and leader in renewable energy generation. Not only will Canoe Reach and Borealis GeoPower's Sustainaville GeoPark signal to other communities that geothermal development is possible, but it will work to expand the small business sector, create employment opportunities, and attract more residents to the Valemount region (Marshall, 2017).



Proposed Sustainaville Development Plan

Borealis GeoPower. (2017, October 10). Canoe Reach Project: Pre-Feasibility Study Completed [digital image]. Retrieved from: http://www.borealisgeopower.com/annoucements/pre-feasibility-study-completed

Geothermal energy fits well into the mandate of a community with significant ties to outdoor amenities and tourism (Personal communication, June 2, 2019). The project will contribute towards community energy security, food security, and sustainable growth of local small businesses and services (Personal communication, June 2, 2019). The potential for a greenhouse at the GeoPark could extend the growing season into the winter months and improve food security in a community reliant on intermittent produce shipments (Ward, 2018). Existing greenhouses in the region have expressed interest in an alternative and more affordable energy source to propane and wood (Valemount Geothermal Society, n.d.). The GeoPark also has the potential to provide a source of low-cost heat and power to niche

industries. One such example is a local microbrewery, Three Ranges Brewing Company, which has hopes to scale and expand its production into a larger facility (Valemount Geothermal Society, n.d.). This represents one opportunity where businesses in the GeoPark might collaborate or share residual waste products (Marshall, 2017).

The project will also create new opportunities for tourism, or "geotourism", including trails, interpretive centres, a tech institute, and a marketplace for local businesses (Marshall, 2017). In this community reliant on intermittent hydroelectric power, Canoe Reach presents a reliable, renewable energy source that minimizes environmental impact and potentially provides Valemount with an opportunity for self-sufficiency (Marshall, 2017).

Future Directions

On May 29, 2018, the British Columbia Oil and Gas Commission, the provincial authority on all geothermal resource wells or facilities since 2017, issued a geothermal resource well authorization to Borealis Geopower Inc. for four thermal gradient wells at the Canoe Reach Geothermal Project site (BCOGC, 2018). This landmark action represents the first time the British Columbia Oil and Gas Commission has issued a well authorization under the new Geothermal Resource Act (BCOGC, 2018). The most recent update by Borealis GeoPower from June 2018 states that fieldwork is in progress and following the four well authorizations granted by the British Columbia Oil and Gas Commission, drilling is scheduled to commence soon. A member of the community shared in personal communication that Borealis GeoPower has plans to continue exploratory drilling in Summer 2019 (Personal communication, June 2, 2019).

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