CASES

ENERGY PROFILE: PETER BALLANTYNE CREE NATION

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COMMUNITY ENERGY PROFILE: PRELIMINARY ASSESSMENT

Peter Ballantyne Cree Nation Communities of Deschambault Lake, Pelican Narrows, Southend, and Kinoosao. Spring 2020

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1 Introduction

This is a draft community energy profile for the Peter Ballantyne Cree Nation (PBCN) communities of Deschambault Lake, Pelican Narrows, Southend, and Kinoosao in Northeastern Saskatchewan. This document contains information which University of Saskatchewan student researchers with the Community Appropriate Sustainable Energy Security (CASES) partnership were able to collect from publicly available sources, without contacting community members or representatives from energy providers.

What is presented here, and in the accompanying workbook of spreadsheets, is an introduction to the energy environment in the communities. Data for all four communities is consolidated in this document. Data from Statistics Canada and Environment Canada is provided separately for each of the communities in accompanying spreadsheets.

Any information that is specific to these communities, and that describes community capacity, patterns of energy use, energy priorities, and most of the elements of energy security, are not included in this report. That information will be collected with and from community members by the CASES research team directly when we are able to collaborate with community members and engage in primary research activities.

2 Regulation and Governance

2.1 Energy Governance at PBCN

PBCN, a partner in the Community Appropriate Sustainable Energy Security initiative (CASES), is investing financial and human resources into energy security through their involvement in the project. Over seven years, PBCN, with The University of Saskatchewan (USask) and the CASES research network will develop a knowledge platform specific to capacity building and northern renewable energy transitions. In October 2018, PBCN signed a Letter of Understanding with the Canadian CASES project partners. There are four PBCN communities involved in the project: Deschambault Lake, Pelican Narrows, Southend and Kinoosao.

CASES is a network of Indigenous organizations, industry/utilities, non-profit organizations, academic partners, and 15 Indigenous and northern communities across four countries. Working in concert with PBCN communities Pelican Narrows, Deschambault Lake, Kinoosao and Southend, CASES will create opportunities to build knowledge, understanding, and capacity, to design, implement, and manage renewable energy systems that support and enhance social and economic values in northern and Indigenous communities.

In 2019, PBCN's economic development arm, the Peter Ballantyne Group of Companies (PBGOC) joined the USask's (CASES) Partnership. PBGOC is a for-profit economic development and investment firm that is wholly owned by the PBCN. The communities, through their relationships with PBGOC, have access to energy developing planning and coordination expertise. PBCN, through PBGOC, put an Energy Program Officer in place in October 2019,

although the key job tasks for this role are not known. PBGOC's partnership in CASES demonstrates a formal commitment to: facilitating renewable energy research and student engagement, co-hosting and facilitating community energy workshops, co-developing community energy planning toolkits, and providing local expertise to the research process. Through its involvement in the CASES initiative, PBCN and PBGOC hope to: co-develop, with CASES researchers, tools for understanding, evaluating, and improving the socio-economic outcomes of renewable energy implementations in remote and northern communities; determine the key success factors for renewable energy transitions in northern communities; determine how to accommodate those key success factors; and share discovered and developed knowledge with communities across the circumpolar north.

The Peter Ballantyne Group of Companies is currently acting as a corporate energy champion for the communities of Deschambault Lake and Pelican Narrows, in that it has been pursuing renewable energy projects over the last five years. PBGOC, with the support of the Clean Energy for Rural and Remote Communities (CERRC) program from Natural Resources Canada, has proposed to install biomass boilers in those communities to offset space-heating propane use in the high schools. The funding application has been accepted by CERRC and a contribution agreement which would fund the project is expected to be signed in April of 2020. PBGOC is treating this as a pilot program and, if the project is successful, plans to expand biomass heat installation, and possibly combined heat and power installations, to other buildings and to other communities within PBCN. Mee-Toos, a company formed by PBGOC, is managing the biomass heat project, where two boilers and one chip plant will be built for schools in the Pelican Narrows and Deschambault Lake communities[1]. A total of $3M is being invested, of which $2M is a CERCC grant, and $1M is the company's own money.

Mee-Toos Forest Products has a sustainable forest license (Term Supply License) that is active at a low level – providing opportunities for residual biomass collection on harvest blocks or for purpose-harvest of biomass. The development of new industries that have large heat demands would strengthen the case for CHP development (surplus of heat in shoulder spring / summer / fall). More heat demand, as long as the heat demand is concentrated spatially, leads to better viability of CHPs. Possible heat consuming industries include commercial fishing (ice production), greenhouse food production, wild rice drying, wood pellet production, and lumber production. New mining complexes on regional traditional lands would require electricity and heat which could possibly be produced in-situ – and there are proposed mining projects with these needs. Global economic forecasts and commodity market forecasts will dictate whether the mines are developed. Only the commercial fishery is active now.

PBCN took legal action against SPC in 2004. The lawsuit seeks reconcile over negative impacts to local cultural Cree rights relating to land use near a dam at Whitesands (Reindeer River near Southend). In December 2019, a ruling by the Saskatoon Court of Queen's Bench ruled that that PBCN has no legal standing for impact benefits relating to the construction of the dam and flooding of the land, which took place for over 80 years. PBCN's legal team state that this contradicts formal Federal and Provincial reserve entitlement negotiations, which began as early

as 1992[2]. The decision is expected to be appealed and there is no certainty about when the case will come to a final resolution.

2.2 Saskatchewan Power Corporation

In 2018, Saskatchewan's combined energy sectors (oil and gas, coal, renewables, uranium, natural gas) were valued at approximately $9.8 billion[3]. A mix of oil and gas, coal, renewables and natural gas provide electricity and heat to Saskatchewan residents. Generation, transmission and distribution of Saskatchewan's electricity supply is primarily managed by Saskatchewan Power Corporation (SPC). SPC was established in 1929 and incorporated as a Crown corporation in 1949 under the Power Corporation Act.

SPC, through its subsidiary NorthPoint Energy, imports and exports power to optimize its revenues and costs. NorthPoint and SPC have transmission interconnection agreements with Manitoba, Alberta, and North Dakota. Interconnection rates are generally limited to 147 mW from Alberta, 150 mW from North Dakota, and 250 mW from Manitoba[4]. With exceptions in the City of Saskatoon and the City of Swift Current, SPC has the exclusive right to supply, transmit and distribute electricity in Saskatchewan. The Crown Investments Corporation of Saskatchewan (CIC) governs the operations and directives of SPC. It is through the CIC that the provincial Minister responsible for Saskatchewan Power Corporation communicates with SPC's Board of Directors and Chief Executive Officer. In 2018, SPC managed 538,000 customer accounts taking in over $2.7 billion in revenue[5].

SPC has an electrical generating capacity of 3,500 mW and an infrastructure capacity of 4,884 mW, with infrastructure assets valued at approximately $12 billion[5]. In 2018, their electrical generation system included: three coal facilities, eight hydro facilities, ten natural gas facilities and six wind facilities; generation capacity from coal facilities is 40% of the total. Major infrastructure investments are going into maintaining and upgrading the provincial natural gas network and hydro projects. The company's generation operations and investments are shifting, as federal mandates (including the Pan-Canadian Framework) are eliminating the use of pollution-intensive facilities in Canada by 2029. The Island Falls Hydroelectric Station (H2), located near the PCBN community of Sandy Bay has 111 mW capacity and will have a $45 million upgrade complete in 2021[5].

Saskatchewan's Independent Power Producers (IPPs) account for 20% of the province's electricity generation. IPPs have procurement contracts that enable SPC to purchase locally produced power and distribute it to consumers. These facilities producing power and selling it to SPC via IPPs include: North Battleford Generating Station, Cory Cogeneration Station, Meridian Cogeneration Station, Spy Hill Generating Station, Red Lily Wind Energy Facility, SunBridge Wind Power Facility, Western Lily Wind Energy Facility, Morse Wind Energy Facility, Loreburn Heat Recovery Facility, Estlin Heat Recovery Facility, Alameda Heat Recovery Facility and the NRGreen Kerrobert Heat Recovery Facility[5]. The major players who hold utility-scale IPP contracts include: NRGreen Power, Concord Pacific, Stanley Energy, Algonquin Power, Northland Power, Suncor, Enbridge and Gaia Power.

SPC has publicly committed to increased investment in renewable electricity generation that will significantly reduce CO2 emissions[6]. Utility-scale wind developments in southern Saskatchewan are increasing, with 647 mW expected to be added to the current 241 mW of generating capacity[7]. SPC is planning more utility-scale solar projects as well, with 60 mW currently in development[8]. Saskatchewan's net metering program currently allows residents or businesses with existing, contracted power production to sell electricity produced via renewable sources for 7.5 cents per kilowatt hour[9]. There is no current opportunity for an individual or business to open a new net metering agreement with SPC, at least if or until the Power Generation Partner Program is re-launched.

SPC owns all transmission and community distribution lines in the province, terminating at the SPC meters at customer locations. There are over 150,000 km of transmission and distribution lines in Saskatchewan[4]. In 2019 SPC invested $7.3 million into transmission line upgrades. The 230 kV I1K line transmits power to Saskatchewan's northern administration district (NAD); it had a $327 million upgrade in 2016[4]. Power on the northern grid comes from the 25 mW Manitoba Hydro Northern Power Purchase Agreement, and from SPC hydro generating assets in the north. The I1K line goes from Island Falls, bordering Manitoba on the east, to Key Lake, located in the north central part of Saskatchewan. Transmission lines extend south from Island Falls and North from Key Lake to complete the northern grid.

2.3 The First Nations Power Authority

Established in 2011, the First Nations Power Authority (FNPA) is mandated to facilitate the development of First Nations-led power projects and promote Indigenous participation in procurement opportunities with SPC. The FNPA is designated by SPC as the first point of contact for prospective First Nations power producers and the FNPA was established, at least partly to assist First Nations power producers in advancing power generation projects to SaskPower[10]. The FNPA describes two types of opportunities for Saskatchewan First Nations who would like to generate power: *community scale (net-metering) projects* of under 100 kW[11] and *community scale projects* of 100kW to 1mW[12]. FNPA projects operate within a specific set-aside of 40mW provided in the 2012 FNPA-SPC Master Agreement by SPC. According to the FNPA, that set-aside is currently used up by flare gas and solar projects scheduled for completion by December 2021.

In 2019, FNPA was contracted to develop a 20 mW solar project, valued at $85 million. This is in addition to the $300 million, 20 mW flare gas project contracted to FNPA in 2018[6]. The FNPA advises Indigenous communities on power generation, sales opportunities, and works with communities to create community energy plans. The FNPA's agreement with SPC provides set-asides for these two developments, totalling 40 mW.

It is not known if there are opportunities within or outside of those set-asides for the FNPA to develop additional utility-scale projects. It is also unknown if there are opportunities outside of the FNPA arrangement for First Nations in Saskatchewan to produce and sell power using SPC transmission and distribution infrastructure. If the FNPA is unable to provide additional set-asides to Saskatchewan First Nations, and if the currently closed SPC net metering and Power

Generation Partner programs are not renewed, The communities would have to attempt to negotiate one-off power purchase agreements with SPC that would allow them to sell electricity in the communities, to industrial clients, or to the grid. There is no legal opportunity in Saskatchewan for First Nations to sell electricity directly to consumers.

Meadow Lake Tribal Council Industrial Investments (MLTCII) was successful with this approach in their 2019 negotiation of an 8 mW power purchase agreement with SPC. MLTCII plans to begin construction in 2020 on a bio-energy centre near Meadow Lake and adjacent to MLTCII's Norsask Sawmill[1]. The organic Rankine cycle combined heat and power unit will provide heat to the sawmill and electricity to the grid. The electricity produced has the capacity to power 5,000 homes.

2.4 Energy Programs and Incentives

Crown-Indigenous Relations Canada (CIRNAC) and Indigenous Services Canada (ISC) provide First Nations, Inuit and Northern communities funding for programs, services, and initiatives. Such funding programs can be found on the Indigenous and Northern Affairs Canada website[13]. However, the communities do not meet the eligibility criteria of all of the funding programs. The following are the funding programs that the communities can apply for:

2.4.1 First Nation Infrastructure Fund (FNIF)

The main aim of the FNIF program is to improve the welfare and environment of the First Nations communities by helping them further develop and enhance the infrastructure of their communities. The program was made to financially supplement the Capital Facilities and Maintenance Program. Eligible infrastructure projects must fall under the following eight categories[14]:

- planning and skills development
- solid waste management
- roads and bridges
- energy systems
- connectivity
- structural mitigation (previously disaster mitigation)
- fire protection
- cultural and recreational facilities.

The energy projects that the communities are looking to work on fall under two of these categories: "planning and skills development" and "energy systems". The communities can apply for the FNIF through the First Nation Infrastructure Investment Plan available for the community. It is worth knowing that the fall of each year is the deadline for submitting the FNIF.

2.4.2 Community Opportunity Readiness

The Community Opportunity Readiness Program is a result of merging the community-based constituents of the Aboriginal business development program, and the major projects

investment fund, which are old community programs that supported economic opportunities. The main aim of the program is to help Aboriginal communities that are pursuing, or want to take part in an economic opportunity, by funding them. This program is available for First Nation and Inuit communities, any organizations and associations they control (except for charitable and religious ones), and their governments (Tribal Councils included). The following activities are funded by the program[15]:

- any activity that brings private sector investments and backs the pursuit of an economic opportunity, like, marketing, planning, feasibility studies, etc...
- any activity that can fill any available equity gaps in community-owned businesses. For instance, commercial development, market development, and business advisory services and training
- business development related activities that come through the development of the community's economic infrastructure

The idea of implementing renewable energy systems in the communities is itself an economic opportunity and most of the activities involved in the process will certainly meet the program's eligibility criteria.

The communities are also eligible for the "Clean Energy for Rural and Remote Communities (CERRC)" funding program, which the government of Canada started on April 1, 2018. The program's main purpose is the reduction of dependence on diesel in rural and remote communities, and it funds projects that help achieve that[16]. Only projects that fit into one of the following streams are eligible to apply:

BioHeat
$55 million is available for conducting feasibility studies and installing proven heating systems, that can replace diesel and any other fossil fuel used for heating. Heating systems can be based on biomass combustion, combined heat and power systems, or district heating systems. Heat must be the main output of the project (electricity can be produced incidentally).

Innovative Demonstrations
$60 million are available in this stream for the creation of new smart-grid, energy efficiency, energy storage, or renewable energy technologies that can replace diesel in the production either heat, electricity or both.

Deployment
The stream with the highest amount of money, where $90 million are available for electricity production through employing renewable energy systems that are available in the market. Electricity must be the main output of the project (heat can be produced incidental) and the project must demonstrate a reduction in diesel or propane use. Because of the need to offset fossil fuel use in the generation of electricity, this funding stream could be appropriate for Kinoosao, but no necessarily for the other communities.

Table 1: CERRC Capacity Streams

Program Component	Expected Range of Funding per project ($)	Projects	Total Program Funding (% of total project costs)
BioHeat	Up to 5 million	~ 20 to 40	Up to 100%
Demonstration	2 million to 5 million	~ 15	Up to 100%
Deployment	4 million to 8 million	15 to 20 projects	Up to 40%
Capacity Building	100,000 to 400,000	TBD	Up to 100%

Source: W. March, "Clean Energy for Rural and Remote Communities: Bioheat, Demonstration & Deployment Program," 2019.

CERRC is a six-year program that will end on March 31, 2024, more detailed information about it can be found on the Natural Resources Canada website[17]. This program is the most suitable funding program for energy development and the implementation of renewable energy systems in the communities. Not only is the program tailored for remote and rural communities, but it also has similar purposes to those of the CASES initiative. We only know about the $3M invested by Mee-Toos in biomass heat systems that had a $2M grant from CERRC, as we mentioned earlier. Other than that, we were unable to find anything about whether the community has applied for any funding programs in the literature. The best way to get such information is by conducting interviews in the community.

2.5 Energy Sector Training and Education Opportunities

The federal and provincial governments both provide funding for employment-related training in Indigenous communities in Saskatchewan. The federal government, through Natural Resources Canada's (NRCan's) Clean Energy for Rural and Remote Communities Program (CERRC), has a capacity building program that is specific to clean energy. The communities' partnership in CASES, through PBGOC, also provides training and education opportunities.

The CERCC Program was launched in March of 2018 with an initial funding pool of $10 Million and the objective to support the "development of energy literacy and local technical expertise through skills training and network participation in rural and remote communities" (NRCan, 2018:5). The program accepted proposals in 2018 and in 2019. The call for proposals for program funding is now closed, but it is likely that further calls will be announced, pending the release of the federal government's 2020/2021 budget.

The CERRC Program supports training programs established by governments, Indigenous organizations, and for-profit or not-for-profit corporations that set-up training programs with durations of up to five years. Individual training projects are expected to apply for between $100,000 and $300,000, but project funding requests outside of that range will also be considered[18]. The program was specifically designed for "community-level capacity building that will increase clean energy opportunities"[19]. Program streams, or priority areas, include:

- Scaling up, modifying or improving curriculum and technical training.
- Development and delivery of training for communities that build skills or knowledge.
- Network development / peer-to-peer learning opportunities.

- Connecting community leaders with each other and supporting/developing community networks or initiatives.
- Community energy planning or community energy literacy.
- Development of community energy plans or community energy literacy for rural and remote communities, on a regional basis.

Proposals outside of these streams could be accepted provided they relate to the program objective of supporting community-level capacity building that will increase clean energy opportunities, including renewables and energy efficiency, and contribute to reducing reliance on diesel in rural and remote communities. The program places a priority on the inclusion of women and youth[19].

The Canada Saskatchewan Job Grant provides funding to for-profit and not-for-profit corporations to train new or existing employees (Saskatchewan, 2020). Applications are now being accepted for the 2020 / 2021 fiscal year, but funding in contingent upon the release of the federal and provincial budgets. The program provides a maximum of 2/3 of eligible training costs, to a maximum of $10,000 per trainee, where the trainee will be employed at the end of the training program. Funding is not available to publicly funded agencies such as governments or First Nations, but is available to incorporated companies, including for-profit or not-for-profit companies owned by First Nations[20].

Indigenous and Northern Affairs Canada (INAC) provides funds for training programs that could be accessed to provide funds for clean energy sector training in or for Peter Ballantyne Cree Nation communities. In Saskatchewan, funding for pre-employment training programs, delivered by Tribal Councils or First Nations, are distributed from INAC through its Indigenous Skills and Employment Training Program (ISET) to the Saskatchewan Indian Training Assessment Group (SITAG). SITAG funds Tribal Councils and First Nations for pre-employment training, or individuals in diploma and degree programs. Specific training programs for clean energy could be developed and delivered by Tribal Councils, First Nations, or their affiliates, based on need and with the support of SITAG and its board of directors. The Chief of Peter Ballantyne Cree Nation sits on that board[21].

Employment and Social Development Canada provides funding for training, often targeted specifically to employment insurance or social assistance recipients. The availability of these funding pools varies according to demand, and according to annual budget allocations. More information can be found at https://www.canada.ca/en/employment-social-development/services/funding.html#wb-auto-5, or through a local Service Canada office.

3 PBCN's Energy Resources

3.1 Human Capital

More detailed information on human capital with respect to renewable energy system management will become available as researchers engage with PBCN community members through interviews and workshops. A desktop scan revealed Census Canada data on the education levels and occupation statistics from three of the PBCN communities. The communities of Pelican Narrows and Southend each include two census subdivisions, separated by on-reserve and off-reserve boundaries, data for the subdivisions is combined to the community level. Statistics Canada data for Kinoosao is suppressed because of the small size of the community.

Because of the high unemployment rates, education statistics and occupation statistics will be presented, to reduce the chance of missing trained workers only because they were unemployed during the census reference period. Education and occupation statistics are extrapolated from a 25% sample of the population and are presented for the population as grouped into categories of all residents over fifteen years of age. Table 2 contains local educations statistics and Table 3 contains local occupation statistics[22].

Table 2: Local Educational Statistics

	Population over 15	No Credentials	High School Diploma	Post-Secondary Credential	Apprentice or Trades Credential	College Certificate or Diploma	University Below Bachelors	University Bachelors and Above
Deschambault Lake	645	420	130	95	25	35	10	30
Pelican Narrows	1565	1040	310	210	45	90	10	60
Southend	660	405	135	125	20	75	10	30

Source: Highest Education Attainment, NOC 2016.

In both sets of tables, Statistics Canada rounds category value to the nearest multiple of five, as a way of partially obscuring data to maintain confidentiality. The rounding can lead to sub-category values not totaling to category totals properly, but this is this highest precision of data that is publicly available. As an example, in the table above, the last four columns are sub-categories of "Post-Secondary Credential" and should total to that value. In the same way, "Post-Secondary Credential", "High School Diploma", and "No Credentials" should total to "Population over 15". A review of the figures and totals above illustrates the loss of precision, but, nevertheless, the figures provide a general indication of education levels in the community.

Table 3: Local Occupation Statistics

	Mgt.	Business, Finance, Admin.	Natural, Applied Sciences	Health	Ed., Law, Social, Community, Gov't	Art, Culture, Rec, and Sport	Sales, Service	Trades, Transport, Equip. Op.	Natural Res. And Agric.	Mfng. and Utilities
Deschambault Lake	10	15	0	15	45	0	25	20	10	10
Pelican Narrows	10	30	10	20	130	0	60	25	40	10
Southend	10	30	10	10	75	0	55	30	15	0

Source: Community Member Occupations, NOC 2016.

3.2 Energy Source Potential

Saskatchewan's forestry sector is important as it provides access to biomass feedstock. An active forest sector leads to the availability of equipment for feedstock procurement and contributes to the availability of skilled labor needed to operate the equipment along the entire biomass supply chain. The commercial forest zone spans across the north-central part of the province. There are currently 6 mills in operation that produce pulp, lumber and other wood fiber products and over 200 small businesses also supplying wood products. The sector employs over 8000 people, fifteen percent of which are Indigenous. In 2017, Saskatchewan forest-product sales exceeded $1 billion dollars[23].

Resources which could be used to produce renewable power in the region include:

- Timber can be harvested specifically for processing into woody biomass feedstocks, or, if sawmills or other primary wood processing facilities are in operation in the region, by-products such as chips, sawdust, bark, and shavings can be used. Typical types of woody biomass used for generating energy include solid wood (logs, split firewood), chips, hog (mill by-products which could include variable proportions of sawdust, shavings, fines, and bark), and pellets. Woody biomass can be used to produce heat directly in woodstoves or boilers, or can be used in a pyrolytic process to produce syngas (or producer gas) which is subsequently burned to produce heat and electricity
- Solar energy, for photovoltaic electricity generation
- Latent heat in groundwater, air, or surface water (lakes) for use in heat pumps
- Wind.

The communities are currently using firewood to generate heat in some residential buildings, and there is one lake source heat pump operation, in Deschambault Lake. There are no known fossil fuel reserves in the vicinity of the communities.

3.2.1 Solar Photovoltaic (PV)

There is physical potential for using solar PV power generation in the communities. However, capital and operating costs will have to be considered before deciding about building a PV powerplant. It is all up to the community and what they want, but the potential is there. There is more information about solar energy potential in communities of Northern Saskatchewan in the pre-feasibility study report[24]. Solar PV potential, as calculated using NASA's POWER data access viewer[25], for each community is shown in Table 2 and in Figure 1. The figures provided for the community of Kinoosao are outlying, significantly higher than the other three communities. Additional sources will be checked to confirm the values.

Table 4: Solar Photovoltaic Potential

Direct Normal (DN) and Diffuse (D) Radiation - PV Potential (kWh / M^2 / Day)				
	Deschambault	Pelican Narrows	Southend	Kinoosao
January	2.32	2.23	1.99	2.00
February	3.81	3.68	3.54	4.25
March	5.80	5.58	5.41	7.21
April	7.33	7.50	7.35	10.39

May	7.87	8.09	7.87	11.43
June	7.77	8.25	8.43	10.83
July	7.73	7.90	7.82	10.25
August	7.17	7.14	6.95	8.85
September	5.15	5.19	5.07	5.75
October	3.73	3.61	3.41	3.74
November	2.52	2.43	2.31	2.41
December	1.71	1.51	1.28	1.20

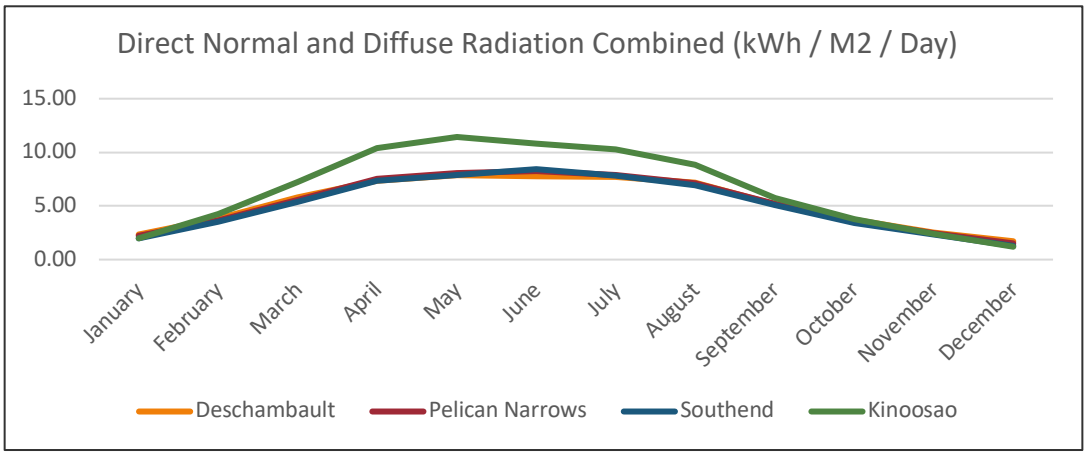

Figure 1: Solar Photovoltaic Potential

Solar power is being considered for these communities because it is proving to be effective in high latitudes in other places. In addition to the high latitude, these communities normally have clear skies. In Alaska, solar PV has shown advantages because it is very robust, which reduces the risks of breaking or wearing out. For northern communities in Saskatchewan, this can also be an advantage, considering that repair equipment would take some time to arrive[24].

Solar PV generation is a good option for northern latitudes when the penetration level is small because the discrepancy between peak generation in the summer and peak load in the winter can be absorbed by the north grid[24].

Solar thermal, for the study of northern communities, focus solely in the collection of heat itself, for example domestic hot water use and space heating. In places where solar resources are high, solar thermal can be used to generate steam and then electricity but this is not the reality of the PBCN communities. For PBCN communities, solar thermal can be a feasible alternative, especially if one solar thermal collector array is connected to a heating loop that distributes to many nearby houses. In addition, solar thermal is a good option because these communities do not seem to have permafrost[24].

3.2.2 Hydro Power

Deschambault Lake, Pelican Narrows, and Southend are in the general vicinity of the Churchill and Reindeer rivers which provides them with some hydroelectric potential. There is an SPC dam and generating station on the Churchill River at Island Falls, near the community of Sandy

Bay, and there is a flow regulation structure on the Reindeer River close the community of Southend (Whitesands). There could be some potential for expanding power production at Island Falls, and possibly for adding power production infrastructure on the Whitesands dam on the Reindeer River – currently used for flow regulation to the Island Falls generating station.

In the Hansard Verbatim Report, a representative of PBCN communities said that they want to implement energy development projects that use water resources on the condition that such projects have low impacts and are sustainable. That representative also said that PBCN can increase the hydroelectric capacity on the Churchill-Reindeer water system by 200 megawatts without any new environmental impacts. He then went about explaining how PBCN communities can achieve that and gave examples of available opportunities and projects[26].

3.2.3 Biomass

CASES researcher Peter Sigurdson suggests that a community firewood initiative could be developed to expand the use of firewood resources for residential heating using wood stoves. He also said that the biomass feedstock potential is upwards of 200,000 oven dry tonnes (ODT / year for purpose-harvest (as opposed to mill residuals)[1]. The 200,000 ODT of woody biomass is available to the communities of Deschambault Lake and Pelican Narrows through the permitting mechanism provided by the Mee-Toos Term Supply License, a timber resource licensing mechanism provided by the Province of Saskatchewan to Mee-Toos Forest Products, part of the Peter Ballantyne Group of Companies. There is no such licensing mechanism currently in place in the vicinities of Southend or Kinoosao, but it is highly probable that some type of Provincial Crown timber license could be made available to those communities. There is also more information about the biomass potential[24].

Biomass for heat alone is recommended without any reservation, but for combined heat and power, there is a possibility that CHP electricity would be significantly more expensive than grid-supplied electricity. Biomass heat only and CHP production can use wood chips, pellets, sawmill residues, or firewood. Technologies range from single interior woodstoves, to outdoor boilers that heat a single house, to industrial boilers producing 100 to 1000+ kWs that work for large buildings or district heat networks. Viable CHP technologies include gasifiers and organic Rankine Cycle combined heat and power units. Biomass feedstock is abundant in areas adjacent to all the communities we are looking at.

3.2.4 Wind

Average monthly windspeeds at the Flin Flon A (WMO compliant) weather station, based on a minimum of fifteen years of observations, range from 9 to 13 km/h (between 2.5 and 3.6 m/s[27]. The Flin Flon A weather station is approximately 100 Kms southeast of Pelican Narrows. The average wind speed required, as a general rule, to support wind energy developments, is more than 4 m/s. As such there is no practical potential for wind power development in the communities supported by the meteorological data that is currently available. This is supported by Huang et. al. (2016) who suggest the collection of wind data near the communities, in the location and at the height where a wind turbine would be placed, as a way of determining absolutely if there is wind power potential. Data collection should continue for at least one year before the data is used to support decision-making.

Wind turbines in the range of 10kW have a higher cost per kW and they have not yet been tested in Alaska. If the communities are willing to use wind energy they will have to risk paying a higher price and also take the risks of trying something that has not been tested in the Northern setting before. Because wind energy depends on local conditions, some communities can have good resources, especially near the shores of big lakes, but it is still unknown if this is the case in PBCN communities[24].

3.2.5 Heat Pumps

Air source heat pumps are robust and have low maintenance requirements. Unfortunately, theyare not economically feasible in deep cold; therefore, they are not recommended for these communities. Ground source heat pumps *are also* robust and have low maintenance requirements. Ground source heat pumps are recommended for these communities, but they requires some skill to install. The negative side is the coefficient of performance (COP) is lower in cold places, and ground may not sufficiently recharge with heat each summer. There is a lake source heat pump in operation in Deschambault, and there is potential for more installations. The one in operation in Deschambault Lake was installed in 2005. Operators mentioned they faced some problems in the first year, but after some time of learning, the heat pump was working well. Lake source heat pumps are recommended for these communities, even though they require for some skill for installation[24].

3.2.6 Local Priorities

As said by Peter Sigurdson, the community prioritizes the use of local biomass over imported propane for space-heating in large buildings. This substitution helps the community generate revenue and retain it. Anything else is unknown to us at this point. We can infer some of the community's priorities from the Appendices of the Amisk-Atik draft Integrated Forest Land Use Plan (IFLUP) published in 2003. In this report, the comments of all participating communities on the draft IFLUP were documented[28]. The communities voiced their concerns about electricity supply and how unreliable it is, due to frequent power outages. We can assume that energy sovereignty is a priority because it contributes to energy security. More accurate and valid information about the community's energy priorities can only be gathered through interviews with community Elders and Councillors and other leaders.

4 Energy Security Baseline

4.1 Local Vulnerabilities

4.1.1 Power Disruptions

In this draft version of the community energy profile we do not yet have data from SPC which could be used to calculate and report on electrical power disruptions from natural disasters or from other causes. That data will be added as it becomes available. In the interim, we can identify some of the threats to the electrical grid and provide some examples of how it has affected access to power in the communities.

4.1.2 Lightning

The main problem these communities face are lightning strikes, which are very common in the area. Lightning can strike approximately 30 times per night, during a storm, which can cause up to 6 power loss cases in the summer (Huang et al., n.d.). When these events occur, the communities can stay out of service for a long period of time. In July 2006, the northern communities of Pelican Narrows and Deschambault Lake faced a power outage of 5 hours caused by a lightning strike to a power pole in Pelican Narrows. The outage implications for the communities was because the lightning also struck a SaskTel microwave tower and this fact delayed the repair because the crew could not access their FleetNet phones[29].

In October 2016, there was a power outage in many northern communities due to heavy snowfall and rain. Amongst other communities, Southend was also affected by the outage. The main implication for the communities, despite being without power, was the quality of drinking water. The communities were advised to boil water for at least one minute before cooking, brushing teeth, washing food, doing the dishes or making ice cubes[30].

The main and critical structures of the 3 communities (Pelican Narrows, Deschambault Lake, and Southend) are likely to be electrically supplied and any disruption to these lines, such as lightning, can affect the supply and critical services in the communities.

4.1.3 Forest Fire

Forest Fires are common in Saskatchewan's northern boreal forests and electrical transmission lines can be destroyed if their path is crossed by a moderately or intensely burning wildfire. A fire in August 2017 threatened transmission lines between Flin Flon and Sandy Bay, and major fires in 2015 threatened communities and infrastructure in central parts of northern Saskatchewan.

4.1.4 Ice and Wind on transmission lines

Extreme weather events are the main cause of power outages and disruption of transmission lines. Northern communities may experience extreme situations such as heavy snowfall, high winds, and ice storms that can damage structures. Wind and snowstorms can lead to the disruption of these lines, leaving the community days without access to energy. Because of climate change, a rise in the severity and frequency of these events has been noted.

4.2 FUEL SUPPLY

4.2.1 Residential Heating

Pelican Narrows, Deschambault Lake, and Southend are connected to the northern SPC transmission grid. Kinoosao is not connected to this grid and is powered by diesel generators. None of the communities have access to natural gas; therefore, they heat residential buildings electrically (except for Kinoosao). There is some significant amount of wood stove usage in the communities, and the Band provides firewood to elders, but the majority of the heat in residential buildings is thought to be provided by electricity.

4.2.2 Heating Large Commercial and Public Buildings

Large commercial and public or community buildings are, as a general rule, heated using propane-fired boilers. Propane is delivered to Deschambault and Pelican Narrows from a distributor in Flin Flon Manitoba and is readily available. Southend receives propane deliveries from a distributor in La Ronge.

4.2.3 Disruptions in Fuel Supplies

Fuel supply disruptions in the Kinoosao community have not been made available. This information can be acquired in interviews with community leaders.

4.3 Energy Infrastructure

The electricity infrastructures of Canadian off-grid remote communities, such as Kinoosao, will be determined by many factors, such as climate, access to resources and how remote the community is. Yet as most of these remote communities are supplied by diesel, they are heavily reliant on imported fuel, thus generating costly energy. The use of diesel generators in these remote communities has proven to be both reliable and stable, but it is a high cost energy alternative that also releases greenhouse gases and can lead to fuel spills.

Table 5: Total Capacity of Fossil Fuel in Kinoosao

Community	Main power source	Fossil fuel generation type	Fossil Fuel capacity kW
Kinoosao	Fossil Fuel	Diesel	350

Table 6: Electricity demand in Kinoosao

Community	Capacity Fossil Fuel kW	Yearly demand mWh/y	Capacity factor %	Year reported	Population	Capacity/ person	Demand /person
Kinoosao	350	190	6.2	N/A	57	6.14	3.3

Information related to the other three communities that are connected to the northern grid is not reliable nor complete, pending further information being made available by SPC. The transmission line from the main section of the grid to each one of the communities is said to be 800 km long and ungrounded (Huang et al., n.d.). Because of this reason, during an electrical storm, the whole line can be out of service. This information needs to be confirmed, the line from Island Falls to Pelican Narrows is grounded, the length and grounding status of other segments are unknown to us at this point[31].

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