Energy Shift: Reducing Diesel Reliance in Remote Communities in BC

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Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

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Abstract

This paper explores the challenges and proposes potential solutions for renewable energy and energy efficiency development in diesel-dependent remote First Nations communities in British Columbia. Through 22 qualitative interviews, (with remote First Nations communities, private and public sector, and non-profit) participants identified the following barriers and challenges to implementing energy projects: small remote communities have limited human capacity to develop large-scale energy projects; current provincial and federal government programs are uncoordinated and difficult to navigate; remote communities pay higher rates for energy, and this under-subsidization creates energy poverty and indebtedness; and the rates and requirements for electricity purchase agreements challenge the economic viability of energy projects. Four policies to mitigate these challenges were considered for this analysis: (1) increasing electricity purchase prices for remote community energy; (2) streamlining grant funding applications; (3) implementing on-bill financing for energy efficiency; and (4) implementing a community-based training program.

Keywords: British Columbia; Public Policy; Remote Community; Renewable Energy; Diesel Generator

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List of Acronyms

AEA	Alaska Energy Authority
BC	British Columbia
CRTP	Circuit Rider Training Program
DSM	Demand Side Management
EMPR	Ministry of Energy Mines and Petroleum Resources
EPA	Electricity Purchase Agreement
GHG	Greenhouse Gases
GNWT	Government of Northwest Territories
INAC	Indigenous and Northern Affairs Canada
IPP	Independent Power Producer
kWh	Kilowatt-hour
LCOE	Levelized Cost of Energy
MIRR	BC Ministry of Indigenous Relations and Reconciliation
MOU	Memorandum of Understanding
mWh	Megawatt Hour
NIA	Non-Integrated Area
NRCAN	Natural Resource Canada
NWT	Northwest Territories
O&M	Operations and Maintenance
OBF	On-Bill Financing
PAYS	Pay as You Save
PPA	Power Purchase Agreement
RCE	Remote Community Electrification
RCE	Remote Community Electrification Program
SFU	Simon Fraser University
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples

Glossary

Remote community	A community in Canada that is not connected to any provincial or territory-wide electricity transmission grid. For this report, a remote community can also be referred to as an off-grid or isolated community.
Microgrid	An electricity generation station and distribution system that provides electricity to a remote community.
Avoided cost of diesel	The cost to utilities to purchase and transport diesel to remote communities (sometimes based on diesel generator efficiency). When utilities develop PPAs with renewable energy systems that reduce the amount of diesel consumed, contracts are typically based on this avoided cost of diesel.
Electricity Purchase Agreement	An Electricity purchase agreement (EPA) or power purchase agreement (PPA) is a contract between two parties, one which generates electricity (the seller) and one which is looking to purchase electricity (the buyer).
Non-Integrated Area (NIA)	The Non-Integrated Areas (NIA) department within BC Hydro operates, maintains and manages all aspects of energy supply (generation, distribution & customer service) for remote BC locations that are not currently connected to the BC Hydro integrated electrical system.
Postage-Stamp Rates	Rate design methodology used by BC Hydro. Postage stamp rates are a method of cost allocation where any rate class charge is the same anywhere on the interconnected system, regardless of the geographical region in the province.
Turn-Down Provision	A provision often included in EPA agreements stipulating that if the demand is low or the renewable power production is high, the clean power project will have to reduce its generation allowing diesel generators to run at a set minimum rate.
Zone II Rates	The rate class for BC Hydro's Non-Integrated area customers.

Executive Summary

There are 27 remote First Nations communities in BC, most of whom use diesel generators for electricity; and heating oil, propane or wood for heat (Royer, 2013). As renewable energy costs decrease worldwide, the economic, social and environmental case for transitioning away from fossil fuels, and toward a greater reliance on more local and sustainable forms of energy is increasingly compelling. Diesel generators produce greenhouse gasses (GHG), cause adverse health impacts, and provide expensive energy.

Many First Nations in BC are committed to abandoning diesel, and have become leaders in the renewable energy industry; however, there are ongoing barriers for decarbonization. Federal and provincial governments have the opportunity to work towards reconciliation by supporting First Nations communities developing their own path towards energy security and autonomy. Well-designed flexible policies and programs can help to accelerate the development of clean energy systems.

This study aims to identify the barriers faced by remote communities in implementing renewable energy projects. Interviews were conducted with energy leaders in remote communities, utilities, provincial and federal government representatives, the private sector, and non-profit organizations. The data from these interviews identified the following as the most salient barriers to displacing diesel in remote communities:

- **Electricity purchase agreements (EPA)**: EPAs are an important enabling factor for renewable energy production in remote communities in BC. However, many communities have found that the price that BC Hydro offers for EPAs is not sufficient to justify a renewable energy project.

- **Access to capital:** There are many grants available for renewable energy projects in remote communities. These grants are instrumental in helping remote communities in raising capital for energy projects. However, participants also noted that the grants are piecemeal and uncoordinated across levels of government and ministries. The grant system is challenging to navigate and places a substantial administrative burden on remote communities.

- **Community capacity:** There are several factors that limit the capacity of remote communities in pursuing energy projects: (1) remote communities have small populations; therefore, they have limited skillsets within the community; (2) there are many competing priorities; and (3) retaining skilled workers is difficult in communities with limited employment opportunities. To address these limitations, participants spoke of the importance of targeted capacity building programs.

- **Economic marginalization:** Literature and economic theory indicate that price-distorting subsidies reduce the incentive for renewable energy implementation. Contrary to this, participants noted that insufficient subsidies were causing energy poverty and intensifying the barriers to accessing capital. Participants across all groups indicated that the current subsidies are not sufficient to enable First Nations Bands to maintain reliable and affordable energy infrastructure.

Policy Options

A variety of policy options were considered to address the barriers identified in the proceeding section. Given the range of obstacles, there was no 'one-size fits all' solution; thus, different policy options have been proposed for each barrier. The four policy options are:

1. Increase the electricity purchase prices to help recognize the value of the social and environmental benefits of renewable energy.
2. Streamline and coordinate existing grants to reduce the administrative burden on remote communities.
3. Deliver training within communities through a circuit rider training program.
4. Create an on-bill financing program to support energy efficiency upgrades in remote communities.

Recommendations

Policies were compared using pre-determined criteria and ranked based on their overall impact. All the policy options performed well in the analysis, and each targeted a different barrier. For this reason, multiple policies were recommended and prioritized based on their overall level of impact. The policies with the most significant impact are the primary recommendations, and those with a less substantial effect and a lower priority and are secondary recommendations.

Primary Recommendations

- **Increase EPA rates**. Increasing EPA rates will increase the economic viability of renewable energy projects, by accounting for some of the social and environmental benefits.

- **Streamline existing grants.** This is a low-cost policy option that can enable communities to more easily access grants; likewise, it would increase the efficiency of federal and provincial government grant administration.

Secondary Recommendations

- **Implement a circuit rider training program and an on-bill financing program for energy efficiency.** Implementing a training program within communities would have a direct impact on skills development. Likewise, on-bill financing would reduce energy costs by enabling more substantial investment in energy efficiency. These projects are secondary recommendations, as they have a narrower scope and smaller impact than the primary policy recommendations.

Chapter 1. Introduction

There are 27 remote First Nations communities in BC; most of whom use diesel generators for electricity; and heating oil, propane or wood for heat (Royer, 2013). As renewable energy costs decrease worldwide the economic, social and environmental case for transitioning away from fossil fuels, and toward a greater reliance on more local and sustainable forms of energy is increasingly compelling. Diesel generators produce greenhouse gasses (GHG), cause adverse health impacts, and are costly to run. Reducing diesel consumption through conservation, energy efficiency, and renewable energy development will support BC's objective of greenhouse gas reduction, while also creating economic development, poverty reduction, environmental benefits, and reconciliation.

The focus of this project is community-driven energy projects, recognizing that First Nations are the authority on their territory. The Government of Canada and the Government of BC have committed to advancing reconciliation and developing a nation-to-nation, government-to-government relationship with Indigenous peoples. Support for socio-economic development is seen as a foundation of needed transformative change. Reducing reliance on diesel in Indigenous communities can strengthen energy self-reliance, and in doing so support the objectives of reconciliation.

Many First Nations in BC are committed to abandoning diesel, and have made strides to doing so; however, there remain barriers to meeting this objective. Well-designed flexible policies and programs can help to accelerate this transition. This paper uses qualitative research to explore the challenges and potential solutions for accelerating renewable energy and energy efficiency development in diesel-dependant remote First Nations communities.

1.1. Policy Problem

Small remote communities that are powered by diesel generators have unreliable and unsustainable energy at a high cost. These communities face economic and technical capacity barriers that are preventing them from transitioning to more sustainable and affordable forms of energy.

Chapter 2. Background

The terms “off-grid community” and “remote community” refer to:

1. Any community not currently connected to the North-American electrical grid nor the piped natural gas network; and
2. A permanent or long-term (5 years or more) settlement with at least ten dwellings. (Royer, 2013)

According to Natural Resource Canada (NRCAN), there are a total of 200,000 people in 300 communities who live off-the-grid in Canada. These communities have small populations, ranging from 20 residents to 23,000 residents (Royer, 2013). Approximately 80 percent of remote communities rely on diesel generators for electricity, whereas the heating needs are predominantly met using heating oil, propane or wood. It is estimated that remote communities consume approximately 215 million litres of fossil fuel annually in Canada (Arriaga, Canizares, & Kazerani, 2014). Table 1 lists the remote First Nations communities in BC, their energy source, and their subsidy provider.

Table 1: Remote First Nations Communities in BC

First Nation	Location	Energy Source	Subsidy Provider
Dease River First Nation	Good Hope Lake	Diesel generators	BC Hydro
Haida Nation	Old Masset	Diesel generators	BC Hydro
Haida Nation	Skidegate	Diesel generators	BC Hydro
Gitga'at Nation	Hartley Bay	Diesel generators	BC Hydro
Heiltsuk Nation	Bella Bella	Diesel generators	BC Hydro
Iskut Nation	Eddontenajon	Diesel generators	BC Hydro
Kwadacha Nation	Fort Ware	Biomass hybrid with diesel generators	BC Hydro
Liard First Nation	Lower Post / Liard River	Diesel generators	BC Hydro
Tahltan First Nation	Telegraph Creek	Diesel generators	BC Hydro
Taku River Tlingit First Nation	Atlin	Micro-hydro with backup diesel generators	BC Hydro
Tsay Keh Dene Nation	Finlay River	Diesel generators	BC Hydro
Uchucklesaht Tribe	Elhlateese	Diesel generators	BC Hydro
Ulkatcho First Nation	Anahim Lake	Diesel generators	BC Hydro
Nuxalk Nation	Bella Coola	Diesel generators	BC Hydro
Da'naxda'xw First Nation	Dead Point	Diesel generators	INAC
Ehattesaht First Nation	Zeballos inlet	Diesel generators	INAC
Gwawaenuk Tribe	Hopetown	Diesel generators	INAC
Hesquiaht First Nation	Refuge Cove	Diesel generators	INAC
Kitasoo Band	Klemtu	Small hydro with backup diesel generators	INAC
Kluskus Nation	Sundayman's Meadow	Diesel generators	INAC
Kwikwasut'inuxw Haxwa'mis First Nation	Gwayasdums	Diesel generators	INAC
Wuikinuxv Nation	Oweekeno	Diesel generators	INAC
Tlatlasikwala First Nation	Hope Island	Diesel generators	INAC
Tsawataineuk First Nation	Quaee	Diesel generators	INAC
Xeni Gwet'in First Nation	Chilco Lake, Lezbye & Lohbiee	Diesel generators	INAC
Dzawada'enuxn First Nation	Kingcome Inlet	Diesel generators	INAC
Nazko First Nation	Quesnel	Diesel generators	INAC

Source: 1 Adapted from Royer, 2013

2.1. The Case for Abandoning Diesel

Diesel electricity is reliable and proven technology; however, there are many negative economic, environmental, and health impacts (described below). Renewable energy technologies have become a viable option to mitigate these negative effects.

2.1.1. Economic Impacts

Energy in remote communities is significantly more expensive than the cost of energy in grid-connected parts of Canada. The price of energy in remote communities can range from \$0.45/kWh to \$2.50/kWh; whereas the average price of electricity in the rest of Canada varies from \$0.06/kWh to \$0.17/kWh (Arriaga, Canizares, & Kazerani, Northern Lights, 2014). The high cost is reflective of the high cost of diesel fuel, and the cost of transporting large amounts of fuel to a remote area by barge, truck, or aircraft (Royer, 2013).

The high cost of energy places a significant financial burden on remote communities and provincial and federal governments who provide subsidies to offset the high cost. The Government of Nunavut estimates that it spends about one-fifth of its annual budget on energy, putting further pressure on already limited resources available for schools, mental health programs, and public housing (McDonald & Pearce, 2012).

2.1.2. Environmental Impacts

Diesel-powered communities have nearly twice the per capita environmental footprint of the rest of Canada, producing approximately 4.8 tonnes of CO_2 equivalent per capita, while the average Canadian emissions are 2.6 tonnes CO_2 equivalent per capita (Arriaga, Canizares, & Kazerani, Northern Lights, 2014). These impacts are especially severe, in arctic climates. Black carbon – the soot produced from diesel generators – darkens on ice and snow which, in turn, quickens the melting process (Royer, 2013).

Furthermore, the rugged landscape and harsh conditions that fuel carriers need to navigate to reach remote communities, make fuel spills a devastating reality for most communities (Royer, 2013). Accidental spills of diesel fuel can generate significant environmental damage and can be costly to remediate. An impact study completed by Lumos Energy indicated that one litre of fuel oil could contaminate one million litres of drinking water, with clean-up costs ranging from \$250,000 to \$500,000 (based on estimates provided by the Insurance Bureau of Canada) (Price Waterhouse Cooper, 2015).

In October 2016, the Heiltsuk Nation, located in BC near Bella Bella, suffered a diesel spill on their territory. Only 6,554 gallons of the 59,924 gallons of diesel onboard the tugboat could be pumped from the vessel before it sank (Heiltsuk Nation, 2017). Since then, the sunken ship has been leaking diesel into an area of enormous ecological, economic, and cultural significance to the Heiltsuk Nation. Spilled diesel entirely blanketed the most important clam beds in Heiltsuk Territory. Fisheries and Oceans Canada declared an emergency chemical contaminant closure of shellfish fisheries for 11 sub-areas around the spill site (Heiltsuk Nation, 2017). This closure area covers the vast majority of Heiltsuk manila clam harvesting grounds; leaving only two sites unaffected (Heiltsuk Nation, 2017). Reducing the amount of diesel entering remote communities will reduce the likelihood of future spills.

2.1.3. Health Impacts

Diesel generators can be very disruptive because they are noisy and produce a pungent odour; moreover, they have been shown to be detrimental to the health of those living in surrounding areas. Studies have shown, that exposure to diesel exhaust affects the respiratory system –worsening asthma, allergies, bronchitis, and lung function (Huter, et al., 2015). There is also evidence that suggests diesel exhaust exposure can increase the risk of heart problems, premature death, and lung cancer (Huter, et al., 2015).

The health risks associated with diesel exhaust are particularly concerning, as First Nations children are disproportionately affected by respiratory infections such as bronchiolitis, pneumonia, and tuberculosis. Furthermore, the prevalence of asthma is 40 percent higher in First Nations and Inuit communities than in the general population (Price Waterhouse Cooper, 2015).

2.1.4. Social Impacts

In many remote communities, diesel generators are already at capacity and don’t have the power required to fuel much-needed infrastructure upgrades, such as housing, health care or broadband connections. Additionally, black-outs and brown-outs can occur if diesel generators breakdown or are not adequately maintained. Power outages impact local services and businesses and can be dangerous in cold, remote locations (Royer, 2013).

Pikangikum First Nation, a remote community of 3000 people in Northern Ontario, has 18-year-old diesel generators that have not been able to keep up with population growth. On a good day, they can produce enough energy to meet their basic needs, and on a bad day one of their generators breaks down leaving them with rolling blackouts resulting in school closures, food spoilage, and closures of the town's grocery store and restaurant (Bombicino, 2016)

2.1.5. Benefits of Community-Owned Renewable Energy Projects

Community-owned renewables can mitigate the negative impacts listed above, and produce many positive outcomes, such as reduction in GHGs, fuel poverty alleviation, local economic growth, job creation, and community pride and resilience (Roelich & Knoeri, 2015). In their paper, Roelich and Knori (2015) noted the many benefits that have been associated with community-owned renewable energy (see Table 2).

Table 2: Benefits of Community-Owned Renewable Energy Projects

Area	Outcomes
Economic	Competitiveness and economic growth
	Job Creation
	Revenue generation
Social	Fuel poverty reduction
	Regeneration
	Skills and education
	Social cohesion
	Fairness
Environmental	Carbon emissions reduction
	Air quality
Self-governance or self-determination	Local accountability & control
	Energy independence

Source: Roelich and Knori 2015

First Nations are uniquely positioned to lead the energy transition and have become active participants in the renewable energy sector, having already built numerous projects in off-grid and grid-connected communities. In a 2017 survey about First Nations renewable energy development in BC, 98 percent of the 105 First Nations represented indicated current involvement or desire to be involved in the renewable energy sector (Cook, Fitzgerald, Shaw, & Sayers, 2016).The study found that the First Nations respondents saw renewable energy as a means to achieve multiple social, political, and environmental objectives beyond economic development (Cook, Fitzgerald, Shaw, & Sayers, 2016).

2.2. Technical Viability of Renewable Energy

There is three ways to reduce diesel use in (1) conservation, (2) energy efficiency, or (3) alternative energy. Renewable energy is a necessary aspect of decarbonizing remote communities. However, demand-side management (DSM) – conservation and energy efficiency– is equally important. Reducing demand can significantly decrease emissions and energy costs. Furthermore, DSM can decrease the renewable energy capacity requirements by reducing the peak loads.

Renewable energy technologies have become competitive with conventional resources in many areas of the world over the last five to ten years. While diesel generators are relatively cheap to purchase, according to a 2012 study by IEA, their high operating costs make them approximately twice as expensive to use to supply remote electricity over a 15-year timeframe (IEA- RETD, 2012). Furthermore, the cost of renewable energy technologies continues to decrease globally, which suggests that the economic case for renewables will continue to improve in the years ahead (IEA- RETD, 2012).

British Columbia has significant potential for low impact renewable energy opportunities; although these vary by region and community. One of the critical considerations in integrating renewable energy is the technologies storage capacity, intermittency, and predictability.

An intermittent energy source is any source of energy or electrical power that is not continuously available due to some factor outside direct control (Natural Resource Canada, 2016). The intermittent source may be entirely predictable, for example, tidal power, but cannot be dispatched to meet the demand of a power system. Intermittent energy sources can be used to displace fuel that would otherwise be consumed by non-renewable power stations (such as diesel generators), or the energy can be stored in the form of renewable pumped storage, compressed air or ice, or in batteries, for use when needed (International Energy Agency, 2012). Table 3 describes renewable power sources that could be utilized in remote communities. It should also be noted, that grid connection is not considered a viable option for remote communities in BC; therefore, I have not considered it in this analysis.

Table 3: Renewable Energy Technologies

Type of technology	Intermittent Power	Description
Run-of-the-river hydropower	No	Hydropower is the extraction of energy from falling water (from a higher to a lower altitude) when it is made to pass through an energy conversion device, such as a water turbine or a water wheel. A water turbine converts the energy of water into mechanical energy, which in turn is often converted into electrical power using a generator.
Solar Photovoltaic	Yes	Photovoltaic or PV devices convert sunlight directly into electrical energy. The amount of energy that can be produced is directly dependant on the sunshine intensity. For example, PV devices can generate electricity even with cloudy weather albeit at a reduced rate.
Wind	Yes	A wind turbine produces power by converting the force of the wind (kinetic energy) acting on the rotor blades (rotational energy) into torque (turning force or mechanical energy). This rotational energy is used either within a generator to produce electricity.
Geothermal	No	Geothermal is energy available as heat emitted from within the earth, usually in the form of hot water or steam. Geothermal heat has two sources: the original heat produced from the formation of the earth by gravitational collapse and the heat produced by the radioactive decay of various isotopes. It is very site dependant as the resource needs to be near the surface and can be used for heating and power generation purposes. High-temperature resources (150° C+) can be used for electricity generation, while low-temperature resources (50-150° C) can be used for various direct uses such as district heating and industrial processing
Biomass	No	Bioenergy is a general term that covers energy derived from a wide variety of material of plant or animal origin. Strictly, this includes fossil fuels but, generally, the term is used to mean renewable energy sources such as wood and wood residues, agricultural crops and residues, animal fats, and animal and human wastes, all of which can yield useful fuels either directly or after some form of conversion.

Source: 2 (International Energy Agency, 2012)

Chapter 3. Existing and Historical Policies

Reducing diesel use in remote communities has been on the provincial and federal government's policy agenda for nearly two decades. Governments have provided subsidies for diesel to offset the high costs and grants for renewable energy projects to support transitioning to renewable energy sources. Provincial and federal governments have recently renewed their commitment to supporting remote First Nations in displacing diesel through the Pan-Canadian Framework on Climate Change and Clean Growth, stating:

> Governments are committed to accelerating and intensifying efforts to improve the energy efficiency of diesel generating units, demonstrate and install hybrid or renewable energy systems, and connect communities to electricity grids. This will be done in partnership with Indigenous Peoples and businesses. These actions will have significant benefits for communities, such as improving air quality and energy security, and creating the potential for locally owned and sourced power generation. (Pan Canadian Framework on Climate Change and Clean Growth, 2016)

This approach acknowledges renewable energy as a means to reduce Canada's GHG emissions to meet legislated targets, and to support Indigenous communities in meeting social, health and economic objectives. This approach is consistent with Canada's objective to work towards reconciliation by building Nation-to-Nation and government-to-government relationships with Indigneous people, and is consistent with the United Nations Declaration of the Rights of Indigenous Peoples Article 23 which states:

> Indigenous peoples have the right to determine and develop priorities and strategies for exercising their right to development. Indigenous peoples have the right to be actively involved in developing and determining health, housing and other economic and social programs affecting them and, as far as possible, to administer such programs through their own institutions. (United Nations, 2008)

The following table provides a high-level outline of the policy instruments that support energy projects in remote communities.

Table 4: Off-grid Energy Policies

Policy Instrument	Description
Subsidies	Remote communities receive subsidies from the federal and provincial government to offset the high cost of diesel electricity
Incentives	The provincial and federal governments provide incentives for renewable energy and energy efficiency in remote communities. These incentives are offered through competitive grants and product rebates.
Electricity Purchase Agreements	BC Hydro can enter into an agreement with independent power producers in remote communities to purchase energy at the avoided cost of diesel.

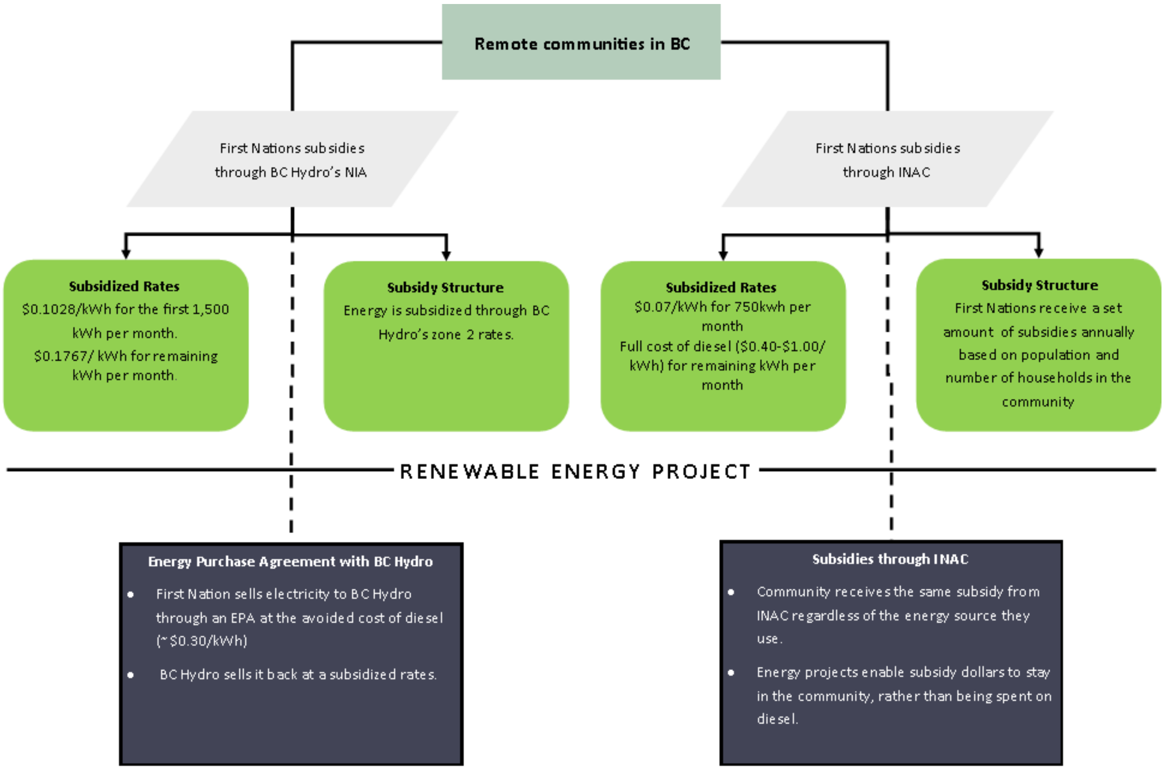
3.1. Subsidies

BC Hydro –the publicly owned energy utility responsible for distributing, transmitting, and generating electricity in BC –provides diesel energy to 14 remote First Nations communities. Indigenous and Northern Affairs Canada (INAC) provides subsidies to the other 13 remote First Nations communities. For this study remote BC communities are distinguished by which subsidy scheme they fall under –those who are subsidized by BC Hydro's Non-Integrated Area program (NIA), and independent communities subsidized through INAC. This distinction is essential, as there are different barriers associated with each of the subsidy structures. The critical differences between the two subsidy models are ownership of assets, subsidy amount, and renewable energy development.

Table 5: Subsidies for Off-Grid Energy

	Communities Subsidized by BC Hydro through the NIA Program	Independent Communities Subsidized by INAC
Ownership	BC Hydro owns and operates the energy infrastructure.	First Nation owns and operates the energy infrastructure.
Subsidies	Electricity is provided to customers at a subsidized rate.	A predetermined amount of subsidy is allocated to First Nation Band.
Renewable Energy Development	IPP's must sign an EPA to sell electricity to BC Hydro.	No EPA required; First Nation Band continues to receive the same subsidy as they would if they were using diesel.

Figure 1 Remote Community Energy Subsidy Structures



3.1.1. INAC Energy Subsidies for Remote Communities

The Government of Canada, through INAC, provides support to First Nations Bands through the Level of Service Standard Policy. Communities receiving this subsidy own and operate their energy infrastructure. The subsidy is calculated using the number and size of community buildings and the number of houses and is provided to annually as a lump sum. Each household is subsidized to a maximum of 750 kWh/month or 9000 kWh/year (Pacific Energy Innovation Association, 2016). The amount of the diesel fuel allowance is calculated as follows:

- For homes = (number of houses * 750 kWh * 30% efficiency * 12 months * price of diesel) – $0.07/kWh.
- Using a delivered cost of $1.10/litre
- Using a diesel efficiency of 3 kWh/litre

Each year, INAC reviews its overall spending versus budget for the country. If there are remaining funds, INAC-BC will review diesel prices versus the start of year estimates (Pacific Energy Innovation Association, 2016). If diesel prices are higher than the assumed $1.10/litre, communities receive a retroactive payment (Pacific Energy Innovation Association, 2016).

Unlike communities who are part of BC Hydro's NIA, First Nations Bands that fall under INAC's subsidy structure do not need to sign an EPA for renewable energy projects. They receive the same subsidy with diesel or alternative energy projects. With alternative energy projects, communities benefit by keeping subsidy dollars in the community, as opposed to being spent on diesel fuel.

3.1.2. BC Hydro Energy Rates for Remote First Nations

As noted, BC Hydro offers diesel energy to remote communities at a subsidized rate, under their NIA program. Remote communities pay $0.1028/kWh for the first 1,500 kWh per month, and $0.1767/ kWh for remaining kWh per month; this is a higher rate than grid-connected BC Hydro customers.

History of the BC Hydro's NIA

From 2007-2013, the NIA was expanded from 4 to14 First Nations communities, through the Remote Community Electrification Program (RCE). The RCE was created through a memorandum of understanding (MOU) between INAC, the BC Ministry of Energy Mines and Petroleum Resource (EMPR), and BC Hydro (BC Hydro, 2008). The RCE program was developed as a mechanism to implement the 2007 Remote Communities Regulation, which mandated BC Hydro to provide electricity to remote communities at rural BC rates. The program was intended to electrify 34 remote communities between 2007 and 2017; including all remote First Nation communities, as well as several civic communities that met the requirements (BC Hydro, 2008). The objective was to use renewable energy, when possible, with the condition of at least 50% renewable energy. The renewable provision was met by connecting several regions to the grid (Dowlatabadi & Rezaei, 2016). The RCE's primary objective was social, not environmental. The intention was to support remote communities by providing more reliable infrastructure, at lower rates.

BC Hydro had limited success in garnering the support of remote communities because they were looking for renewable energy solutions, whereas the RCE supported the continued use of diesel energy (Dowlatabadi & Rezaei, 2016). Another point of contention with the RCE was that First Nations Bands would have to transfer generation assets and responsibility for power provision to BC Hydro. This was in some cases viewed as oppositional to communities' goals of self-sufficiency (Dowlatabadi & Rezaei, 2016).

From 2007 to 2013, RCE connected five remote communities to the BC provincial grid. In this same period, BC Hydro signed MOUs with five other communities (Dowlatabadi & Rezaei, 2016). Under these MOUs, BC Hydro was to assume responsibility for electricity generation and ownership of diesel generators. In December 2013, the RCE was cancelled; however, BC Hydro continued to work with communities in the later stages of the RCE implementation (BC Hydro, 2008). The cancellation of this program left 13 First Nation communities under INAC's subsidy structure.

3.2. Electricity Purchase Agreement

BC Hydro procures clean power from independent power producers (IPP) in remote communities by negotiating an EPA. An EPA is a long-term agreement between the owner of an electric generating facility and the wholesale energy purchaser (in this case BC Hydro). An EPA allows the facility owner to feed electricity into the transmission lines, and to secure a revenue stream from the project, which is often necessary to finance the project. Typically, EPAs address issues such as the length of the agreement, the commissioning process, the purchase and sale of energy, price, curtailment, milestones and defaults, credit and insurance.

For remote community EPAs, BC Hydro will purchase electricity at a rate of ~$0.30-0.40 /kWh; BC Hydro will then sell the energy back to the community at a subsidized rate (~$0.11/kWh). Understandably, BC Hydro will not purchase more than the peak load, so the remote IPPs cannot sell any surplus. If the IPP produces 100% of the electricity with renewables, BC Hydro will turn-off the generators and leave them on standby for backup power. If the community uses a diesel-hybrid system, BC Hydro may turn-off one or more of the generators to reduce output.

Obtaining an EPA is often essential for the success of a project because it enables communities to secure funding at a low-interest rate. To date, BC Hydro has only signed EPAs with six of the 14 remote First Nations communities. Five are active

EPA agreements with IPPs –Bella Bella, Bella Coola, Taku River Tlingit First Nation, Sandspit, and Kwadacha First Nation. Gitga'at First Nation has also negotiated an EPA with BC Hydro for the subsequent construction of a clean power project (BC Hydro, 2017)

3.3. Grants

Grants are provided by provincial and federal governments to incentivize and enable the transition from diesel. There are five national programs and six BC programs; some are exclusively targeted at remote community energy, others have a broader mandate (listed in Table 6). Funding is available for community energy planning, feasibility and pre-feasibility studies, and construction costs. Funding is also available through non-profit organizations; however, these are outside of the scope of this analysis.

Table 6: Grants for Remote Community Energy Projects

Federal Policies	Ministry	Description
Indigenous Business and Entrepreneurship Development	Indigenous and Northern Affairs Canada	This program works with Indigenous entrepreneurs and its partners to provide a range of services and supports that promote the growth of a strong Indigenous business sector in Canada.
Community Opportunity Readiness Program	Indigenous and Northern Affairs Canada	Provides financing to Indigneous communities for pursueing an economic development opportunity.
First Nation Infrastructure Fund	Indigenous and Northern Affairs Canada	Supports a wide range of infrastructure projects that are on reserve, Crown land or land set aside for the use and benefit of First Nations.
BC Indigenous Clean Energy Initiative	Western Economic Diversification (administered by New Relationships Trust)	BCICEI funding supports the planning and implementation of clean energy projects, such as hydro, wind, biomass, solar, marine, or geothermal projects. Other initiatives may include energy efficiency projects, energy storage, and reducing dependency on conventional diesel power generation.
Reducing Diesel in Remote Communities	Natural Resource Canada	The program targets three key areas: 1. Innovative demonstrations to reduce diesel use in remote communities 2. Deployment of renewable energy technologies to reduce reliance on diesel in remote communities, and 3. Bio heating program to reduce fossil fuel use to reduce dependence on fossil fuels in remote communities.

Provincial Policy	Ministry	Description
The BC Rural Dividend	Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Provides funding opportunities to assist rural communities with a population of 25,000 or less to reinvigorate and diversify their local economies.
Innovative Clean Energy Fund	Ministry of Energy, Mines, and Petroleum Resources	This program is funded through a levy on certain energy sales, designed to support the Province's energy, economic, environmental and GHG reduction priorities, and to advance BC's clean energy sector.
Community Energy Leadership Program	Ministry of Energy, Mines, and Petroleum Resources	This program supports local government and First Nations capital investment in energy efficiency and clean energy projects.
First Nations Clean Energy Business Fund	Ministry of Indigenous Relations and Reconciliation	The fund provides agreements between the BC Government and successful applicants for capacity funding and equity funding. It also includes revenue sharing agreements between the BC Government and eligible First Nations.
Power Smart Sustainable Communities Program	BC Hydro	This program helps local governments improve their energy efficiency and reduce your GHGs by providing expertise, education, and financial incentives.
BC Hydro Energy Conservation Assistance Program (ECAP)	BC Hydro	Income-qualifying customers are eligible for a free Energy Saving Kit, and a free home energy assessment, products and advice.

Chapter 4. Data Description

The purpose of this study is to formulate and analyze policy options that accelerate renewable energy and energy efficiency development in remote communities to reduce energy costs and environmental impacts and promote economic growth. This approach aims to identify existing policy gaps, to inform how communities can be better supported in reaching their energy objectives. Recognizing that First Nations are the rightful authority on their territory, policies will be non-prescriptive to allow for flexibility and self-determination in energy development.

4.1. Methodology

This study uses qualitative analysis to determine current short-comings and practical policy solutions. Remote communities who are developing energy projects have first-hand knowledge about the barriers to reducing diesel, and how they could be better supported in this endeavour moving forward. Provincial and federal government officials, academics, the private sector and non-profits who have worked with First Nations on these projects can also provide insight into the current policy context and policy barriers. The methodology for the study uses three qualitative components:

- A literature review of policy papers on remote community energy
- Interviews with remote community representatives
- Interviews with government, non-profit and private sector

4.1.1. Literature Review

A review of relevant literature was used to identify the scope of the problem, contextualize the issues, and provide a higher-level understanding of the barriers that communities face in reducing diesel.

4.1.2. Interviews

A semi-structured interview format was used to allow for flexibility in the interview process and to encourage dialogue with the participants. A thematic analysis was used to identify recurring themes and establish commonality within the data (Braun & Clarke, 2006). The thematic analysis consists of researchers familiarizing themselves with the data, generating initial codes and themes and then refining the themes to produce a final report (Braun & Clarke, 2006).

Interview participants were given the option of being identified, and most participants chose to remain anonymous. Maintaining anonymity allowed the interview participants to share information openly and candidly.

Community Interviews

Interviews were conducted with representatives from four remote First Nation communities, at various stages of developing renewable energy systems. The purpose of these interviews was to identify the most salient barriers for the communities in implementing renewable energy systems, as well as potential solutions for overcoming these barriers through policy change.

Stakeholder Interviews

Interviews were conducted with government officials, academics, non-profit organizations, and private sector companies. The purpose of these interviews was to gather information about existing policy barriers, policy history, and potential solutions The interviews were semi-structured, and questions were targeted for the area of expertise of each participant.

4.2. Reflexivity

Throughout my research, I worked too in incorporate reflexivity. This is a process that challenges the researcher to explicitly examine how his or her research agenda and assumptions, subject location(s), personal beliefs, and emotions enter their research. It is important to note my social location in undertaking this research. I approached this study with middle-class status, and I am privileged by society for many other facets of my identity. I am white, able-bodied, university educated, and reside in an urban centre.

Given that I am not Indigenous, I do not pretend to know or understand the lived experiences of Indigenous peoples. It is not my intention to suggest that I have insights about the First Nations' approach to developing or managing renewable energy projects; I do not feel qualified to comment on that. Instead, this paper seeks to inform how the provincial and federal government can improve policies to accelerate community-led energy development. This approach recognizes that remote First Nations communities are diverse and have different motivations and objectives for pursuing renewable energy projects and policies should allow for this.

Chapter 5. Literature Review

There is an existing body of literature outlining the challenges to implementing renewable energy in off-grid communities. This research is primarily written from a national or international context. This section provides a higher-level overview of the barriers to decarbonizing remote communities. Interview data will build on this information, and identify the barriers that are most pertinent in the BC context.

5.1. Economic Barriers

The traditional argument has been that once renewable energy technologies reach “grid parity,” the market will respond, and renewables will automatically begin to replace fossil generation – in the case of diesel this argument is particularly strong (IEA-RETD, 2012). However, evidence suggests that this has not occurred on the scale conventional economic theory would predict, even in remote areas where renewables have already reached or surpassed grid parity (IEA- RETD, 2012).

5.1.1. Price Distorting Subsidies

The cost of providing energy to remote areas has traditionally been either borne by public utilities or the federal governments (IEA- RETD, 2012). Most remote areas do not pay the full costs of their energy services. From an equity perspective these subsidies are essential; however, energy subsidies of this sort encourage inefficient patterns of energy use and represent a rising cost for many governments and ratepayers worldwide. The economic argument states, if subsidies were lower there would be a stronger incentive for renewable energy development.

5.1.2. Social Cost of Diesel

The price of diesel is further distorted by the social and environmental externalities that are not accounted for in the market value. Numerous studies have attempted to estimate these non-market values. This value is referred to as the social cost, which is a measure of the private cost and externalities.

The Gwich'in Council International conducted a study about the social cost of diesel in the Canadian Territories. They estimated the social cost of diesel and natural gas by valuing: the variable fuel costs, non-fuel operating costs, health and social costs, environmental damages, and government subsidies (Gwich'in Council International, 2017). The study used values from studies calculating the social cost of thermal power generation using oil products or natural gas in the US. These values were used as a proxy for the social of diesel in the Canadian Territories. Their overarching conclusion is that the human and ecological costs of diesel fuel is approximately 19.2 cents /kWh (CAN$2016) (Gwich'in Council International, 2017).

Similarly, Price Waterhouse Cooper calculated the economic value of Wataynikaneyap Power Project –a First Nations owned project connecting 16 off-grid First Nation communities in Ontario to the central grid. They used a sustainable return on investment metric to estimate the benefits of this project, accounting for the: (1) financial return on investment, (2) present value of avoided GHG emissions, (3) present value of reduced adverse health impacts, (4) present value of reduced damage to vegetation, and (5) present value of avoided diesel spills. (Price Waterhouse Cooper, 2015). Their findings outlined in Table 7 indicate that economic benefits of grid connection are significantly higher than the financial return on investment would indicate.

Table 7: Economic Cost of Displacing Diesel

Mean Expected Values (2021 CAD$, Millions)	
Financial Return on Investment	$1071
Present Value of Avoided GHG emissions	$472
Present Value of Reduced Adverse Health Impacts	$304
Present Value of Reduced Damage to Vegetation	$35
Present Value of Avoided Diesel Spill	$21
Net Present Value	$1903

Source: 3 Price Waterhouse Cooper, 2015

These studies do not directly calculate the social cost of diesel in remote communities in BC; however, they indicate the considerable social and environmental costs that are not being accounted for in diesel power generation. Incorporating these values into the price of diesel would create a much stronger case for renewable energy production.

Avoided Cost of Diesel

Provincial and territorial governments, energy regulators, and utilities often assess the economic viability of alternatives to diesel using the avoided cost of diesel. The avoided cost of diesel is a logical model, and ensures that there will be no additional costs incurred by the ratepayers; however, there is no consensus as to how the avoided cost of diesel is calculated (Gwich'in Council International, 2017). There are a variety of interpretations of the avoided cost of diesel in jurisdictions across Canada. However, they often only account for the price of the fuel. In some instances, they consider fuel plus delivery costs, including some of the transport and storage costs (Gwich'in Council International, 2017). They rarely account for the reduced operations and maintenance costs or the increased lifespan of the energy infrastructure (Gwich'in Council International, 2017).

5.1.3. Access to Capital

The high upfront cost of renewable energy and energy efficiency means that access to capital is a crucial aspect of a successful project. The International Energy Agency noted that the economies of remote areas vary widely, however there three common factors that often lead to remote communities having lower purchasing power and access to capital:

- **The economies of many remote areas are not diversified**, which makes them vulnerable to shifts in key industries or commodities.
- **The cost of living in many remote areas is comparatively high** (UN DESA, 2010). Even if a remote area has a higher per capita income than a non-remote area in the same country, it is possible that the remote population will be comparatively poor because of the higher costs of consumer goods and commodities (such as energy).
- **There is generally less availability of capital** because investors are often less interested in remote areas, and communities cannot gain access to available capital. When capital is accessed, the cost is generally high (i.e., high-interest rates).

5.2. Technical

The geographic remoteness of off-grid communities presents additional challenges in building and maintaining renewable energy systems. Renewable energy technologies often require specialized equipment to be constructed, which is usually not available in remote areas. For example, many remote areas lack both the handling equipment and cranes necessary to erect megawatt-scale wind turbines (IEA- RETD, 2012). In this case, communities may need to use several smaller units (e.g., 100kW turbines) to meet their required capacity. They may also opt to install refurbished or recycled turbines, as older sites are repowered with larger, more efficient turbine models. This was the case with the off-grid community of Ramea Island in Newfoundland. However, using older equipment may create additional O&M and logistical challenges by increasing the need for technical services (IEA- RETD, 2012).

In the longer term, premature failure can occur if remote communities do not have access to proper supplies and trained technicians required to operate and maintain their system.

5.3. Social Barriers

5.3.1. Community Capacity

Limited community capacity is a common issue in remote First Nations communities. Small populations limit the diversity of skills within a community and make it challenging to lead, manage, finance and construct energy projects. The skills required to develop clean energy projects successfully can take years to acquire, and most remote communities have to start from square one (Henderson C. , 2013). In many cases, there is also a lack of trained workers for project construction and operations and maintenance (IEA- RETD, 2012).

The geographic remoteness and the relatively small size of remote renewable energy systems can make it difficult for project developers to create training programs for residents in a cost-effective manner. Furthermore, local government and utilities may not have the resources or the expertise to organize training programs (IEA- RETD, 2012).

5.3.2. Political

Communities often welcome local renewable energy projects; however, it has also caused controversy in both non-remote and remote communities for a range of aesthetic, environmental, and cultural reasons. Implementing a renewable energy system requires careful consideration about how local communities will receive the addition to their community and how it will fit into their cultural context (IEA- RETD, 2012). Whether the project is community-owned or owned by a private company, meaningful and appropriate community engagement at the conception stage of the project is necessary to receive social licence.

In the BC context, First Nations energy projects have a political component. BC Hydro has a historical legacy of disregarding First Nations rights in the creation of large-scale energy projects. The construction of the WAC Bennett dam and reservoir, in the 1960’s, displaced First Nations communities, erased hunting and trapline territory, disrupted migration routes and transformed aquatic life in the valley's waters –with little to no consultation with First Nations (BC Hydro, 2015). Moreover, several of the communities displaced by the dam were not connected to the grid; despite having power lines running through their traditional territory, they continued to rely on diesel electricity. Although First Nations have taken steps to reconcile the relationship with BC Hydro, there is lasting mistrust and tension.

In their study, Dowlatabadi and Razaei explore the relationship between BC Hydro and remote First Nations through community interviews. They found that a desire for self-sufficiency was a primary motivation for First Nations energy projects. Interview participants were seeking both material self-sufficiency and political self-determination (Dowlatabadi & Rezaei, 2016). Dowlatabadi and Razaei explain that political self-determination suggests that community energy projects are effectively a process of decolonization (Dowlatabadi & Rezaei, 2016).

Chapter 6. Interview Data

I conducted a total of 22 interviews with remote First Nations energy leaders, professionals in academia, federal and provincial agencies, the private sector, and the non-profit sector. It was useful to seek the insights of professionals from multiple domains to capture varying perspectives regarding the nature of the problem in BC.

I completed interviews from January 2017 to March 2017, by phone or in person depending on the preference of the interview participants. The average length of an interview was 1 hour. Responses regarding the nature of the policy problem and solutions vary according to individual exposure to the topic and role in the field of practice; however, there were many common ideas and few differences. Many of the broader concepts offered in interviews are present in the literature; although, the interview data elaborates on these ideas and applies them to the BC context. Concurrently collecting and analyzing the data provided the ability to see where data was lacking, to ask questions missed in other interviews, and to determine when data collection reached theoretical saturation and interviews were no longer providing new insight.

What emerged out of the interview data was a number of diverse yet interconnected themes. To balance opposing voices, more weight was given to responses from interview participants from remote First Nations communities. The initial intent was to compare opinions across groups; however, there was general agreement amongst participants. This is likely because all the interview participants were First Nations representatives, or were supporting First Nations in meeting their energy objectives. To avoid redundancies, the themes were presented together and not broken out by interview participant group, as was initially intended.

6.1. Economic Viability of Renewable Energy

6.1.1. Under-subsidization

Literature and economic theory indicate that price-distorting subsidies reduce the incentive for renewable energy implementation. However, participants did not report this as an issue. On the contrary, participants noted that insufficient subsidies were causing energy poverty and intensifying economic barriers faced when implementing renewable energy projects. Participants across all groups expressed that the subsidies provided by INAC, through the Level of Service Standard funding scheme, are not sufficient to enable First Nations Bands to cover their costs, resulting in growing budget deficits and poorly maintained infrastructure.

As noted in the previous section, INAC provides energy subsidies for remote First Nations communities for the first 750 kWh of energy used per household per month. Once households have used the 750 kWh of electricity, the community is required to pay the unsubsidized rate for energy ($0.40- $0.75 /kWh). To contextualize this number, non-electrically heated homes in BC use an average of 1,250 kWh/month. Homes on remote First Nations reserves often have very little insulation or power smart equipment due to limited funding, leading to higher than average electricity consumption. According to the Pacific Energy Innovation Association, the average electricity consumption is approximately 1,800 kWh/month (Pacific Energy Innovation Association, 2016). Thus, under the Level of Service Standard subsidy structure, the average household in a remote community could pay upwards of $300 per monthly electricity bill. Residents will often not be able to pay these excessive rates, requiring bands to make up this deficit by using funding from other programs, such as health, education, or housing. This creates a cycle of increasing indebtedness, making it extremely difficult for First Nations to take on loans, or raise capital within the community.

These prohibitively high costs also cause communities to avoid routine maintenance to save money, resulting in increased breakdowns, power cuts, and ultimately generator failure. When this occurs, INAC provides “emergency capital” for a new generator, but because the funding is limited and the procurement is rushed, it often results in a cheap but overpriced and poor-quality replacement (Pacific Energy Innovation Association, 2016).

The underfunding for electricity costs is amplified by underfunding in many areas on reserve, including housing. This is true for communities who are part of the BC Hydro’s NIA and communities receiving subsidies through INAC. The lack of funding for housing leads to poorly built and maintained houses that don’t last and need to be frequently replaced. A First Nations energy champion from a remote community explained:

> [INAC] says [to First Nations]: 'here is 20% of the estimated cost to operate and maintain your buildings –you come up with your own source of revenue to pay the rest'. The First Nation most often won't have a source of revenue. Because [the First Nation] doesn't have funding to maintain the assets, they don't have money to hire qualified people…So now you have to pay a lower wage, but even with a lower wage you still can't operate and maintain that building, so it starts to fall apart. A life expectancy of a house on reserve is less than 25 years, but off reserve it is 60-70 years. You end up with an ever-repeating cycle of having to rebuild these assets at least twice the frequency that you do anywhere else in Canada, and this is a function of Canada totally underfunding the O&M of assets on reserve. (Anonymous, 2017)

Ratepayers in BC Hydro's NIA are subsidized at a higher rate than communities whose energy is subsidized by INAC; however, they still pay more per unit of energy than grid-connected BC Hydro customers. They are also impacted by the same issues of poorly maintained houses resulting in excessive energy consumption and costly energy bills.

6.1.2. Electricity Purchase Agreements

EPAs are a key enabling factor for renewable energy production in remote communities. Many provinces still do not have EPA policies, which has been a significant barrier to unlocking renewable energy potential. BC Hydro has a policy in place to enter EPAs with remote communities; however, there are ongoing issues about the price that BC Hydro is willing to offer and their interconnection requirements.

EPA Price

EPAs are negotiated confidentially for every individual project. Anecdotally remote IPPs will often look for $0.60 per kWh in a contract; however, the price usually ends up being closer to $0.30 per kWh. This rate is calculated from a combination of a 10-year average diesel fuel commodity price plus the cost of transporting the diesel to the remote community. The final cost per kWh is calculated based on the local diesel generator system efficiency.

EPAs do not usually account for the value of reduced O&M or the extended life of the generator. BC Hydro continues to operate and maintain their diesel generators regardless of the implementation of renewable energy, to ensure backup power in the case of black-outs or brown-outs. However, some exceptions have been made for clean power projects that operate year-round and meet community's total energy demands. In this case, BC Hydro includes a small capacity payment which accounts for not having to turn-on the local diesel generator(s).

Interview participants had differing opinions about the methodology that should be used for calculating EPA rates. Some participants indicated that the avoided cost of diesel is sufficient to incentivize renewable energy; whereas others stated the price should account for the social cost of diesel –accounting for the social and ecological benefits. The primary concern with using the social cost of diesel was the impact on electricity rates.

Interconnection Requirements

The economics of renewable energy projects are made worse by BC Hydro's interconnection requirements. BC Hydro often puts a provision in their contracts requiring their generators to run at efficient levels –referred to as the "turn-down provision." Meaning, if the demand is low or the renewable power production is high, the clean power project will have to reduce its generation allowing diesel generators to run at a set minimum rate instead of ramping-down or off (Lovekin, Dronkers, & Thibault, 2016). BC Hydro has this provision because if the generator is not running efficiently, it will require additional maintenance, and wear out more quickly. However, this limits the amount of energy that communities can sell to BC Hydro. Communities that are constructing diesel hybrid systems may only be able to sell a portion of the energy that they produce to BC Hydro, significantly reducing the economic justification of a project.

An interview participant who works in the renewable energy industry expressed the challenges that one community faced when negotiating an EPA for a small renewable energy project in a remote community:

> [BC Hydro's] policy was that if they were going to start up their diesel generators, they would need to be running at full efficiency. If the diesel [generator] was not running efficiently, the renewable energy source would have to shut down to allow for the diesel to run efficiently. So that meant that the whole shoulder season fall/winter, it would be no longer possible to run the renewable energy source. BC Hydro could have chosen to put in a smaller diesel system to top up the hydro, but they were not willing to talk about that. This project is on hold for the time being. (Anonymous, 2017)

Given, that most communities will implement hybrid systems as they are transitioning off diesel, BC Hydro may need to consider modifying or down-sizing existing diesel generators to accommodate the production of renewable energy.

6.2. Access to Capital

As noted there are many grants available for renewable energy projects in remote communities. These incentivize renewable energy production and provide communities with capital. The participants recognized that the grants are beneficial for community energy projects; however, they also noted that the administration of the grants could be improved. Participants noted three fundamental problems: fragmented and uncoordinated grants, processes that favor vendor-driven proposals, and the criteria favors larger communities.

6.2.1. Piecemeal Grants

Research participants across all groups noted that grant funding is very fragmented; requiring communities to apply for upwards of ten grants for a single project. Furthermore, each grant has different criteria, application requirements, and application timelines. Participants noted that they often have to wait months to hear back from funding bodies, causing uncertainty and project delays. Additionally, the level of detail required for applications and reporting puts a strain on the limited resources and capacity of communities. The following quote illustrates participant's experience of accessing funding:

> Each ministry has its own criteria, one ministry's criterion is the reduction of GHGs, and another is something else… Some of these applications are large; the one for NRCAN was about a 31-page application –it's huge! Then you go to the next one, and you figure, "oh I will just be able to copy and paste," but no! There is just enough difference that you have to do the whole thing over again with different criteria. What makes it worse, is this application deadline is in November the other is in December, and the other isn't until February. We have all these applications out, but we haven't gotten any confirmation of anything yet. It really makes things difficult. (George Colgate, 2017)

Energy Efficiency

Participants also noted that government silos and prescriptive programs create barriers to energy efficiency. Energy efficiency and housing are managed separately, despite their overlap. Interview participants described that many of the houses on reserve have broken windows or mould. These issues need to be addressed before implementing any energy efficiency upgrades; however, BC Hydro will not repair windows or mould because it is outside of their jurisdiction. This is the case for BC Hydro's Energy Conservation and Assistance Program, which is intended to fund energy efficiency upgrades for low-income residents. These strict parameters lead to many households being ineligible for otherwise beneficial programs and services.

Participants noted that energy efficiency programs are prescriptive and often not designed for the realities in remote communities. There is a need for increased flexibility for energy efficiency programs, and improved coordination between housing programs and an energy efficiency programs.

6.2.2. Vendor-Driven Project Applications

Under the current funding model, communities apply for a grant and if approved are provided the funding to complete the project. Under this model, participants noted that plans were often conceived and developed by vendors (such as engineering firms) rather than the recipient communities. In many instances, a vendor who is knowledgeable about the available grant programs will approach a First Nation community with an idea for a specific renewable energy project. Upon gaining the community's support, the vendor will apply for funding on behalf of the Band Council.

Participants explained that vendor-driven projects rarely benefit communities. In these situations, vendors obtain grants, deliver the service (often a report on community energy planning or project feasibility) and leave the community without any guidance on how to move to the next step. These reports will often sit on a shelf, collecting dust. Furthermore, grants allow the vendors to set a price for their services based on the funding that is available; which may not be reflective of the market value of this service. The following quotes illustrate interview participant's three participants experiences.

Quote 1:

> Some communities have been very well studied, and have done feasibility study after feasibility study, without getting to the implementation phase. This is often initiated by engineering companies who will approach communities pitching their services – the engineering firms may secure grant funding available to First Nation communities through the federal and provincial government. Once the feasibility study is done, the engineering company will be gone, and communities will be left to decipher the feasibility study and try to plan for next steps. If nothing is done the feasibility study may be considered outdated, and another one will be done – and so the cycle continues. (Anonymous, 2017)

Quote 2:

> There is a massive industry in people applying for First Nations grants, writing a report then putting it on the shelf. Then writing another grant, and report and putting it on the shelf. When I went to [one remote community], there were 15 reports done on what they could do with renewable energy, but no one in the community had the capacity to look at the report. So, I was hired to look at the 15 and make one report of the information from the 15. (Anonymous, 2017)

Quote 3:

> I am sitting on an advisory council for a BC Indigenous Clean energy organization, and we are getting a lot of proposals. Some of them are not very good, and some of them are awesome and clearly written by a downtown Vancouver engineering firm with no community input whatsoever. This is clearly an engineering driven proposal with no input from the community. We're not going to fund some engineering firm to make a bunch of money and have the community spin its wheels. (Anonymous, 2017)

Despite the negative experiences, there are remote First Nations communities who have had positive experiences working with vendors, even when the project proposal was developed by the vendor. Some vendors are very committed to supporting First Nations communities in reaching their energy goals. There are also examples of training and mentorships being provided to community members, as well as contractors arranging for community meetings to engage the community about the project.

6.2.3. Criteria for Grant Funding

Several participants noted that small remote communities are repeatedly overlooked for grant funding because their projects have a more modest impact than similar projects in larger communities. For example, in a larger community, an education grant may be used for 20 youth, whereas in a small community this may only be used for 5 youth. Larger communities can create more impact with the same dollars, because of economies of scale. Therefore, they are often favored when it comes to grant applications. This has contributed to remote communities falling behind in economic development. One of the participants expressed his experience with this, saying:

> We do our best we allocate scarce resources to write a [grant] proposal that meets the criteria. We write to the best of our ability. We even stretch a bit on some things that might be achievable, so we can have the best chance…. [But] when decisions makers [review the applications] and say I am going to spend $150,000, and that is going to put 5 people through the system in Atlin, and in Terrace it is going to put 20 people. It's a pretty easy decision, and I appreciate that. Except for that has been going on for a couple of generations. During this time remote communities have not had the capacity development that everyone else has had. (Anonymous, 2017)

6.3. Social Barriers

6.3.1. Community Capacity

Community capacity was a theme highlighted in literature and was a central theme in many interviews. First, I would like to acknowledge that the legacy of colonization has had a fundamental role in limiting community capacity on First Nations reserves. At a more practical level, remote communities have small populations, and the limited employment opportunities making it difficult to retain skilled workers. First Nations governments are required to manage many competing priorities with limited resources making it difficult to take on additional projects. One interview participant shared the following example:

> I went to one community, and they said, "we are having a lot of problems with power, and we are thinking about DSM." So, I suggested starting a little committee to monitor the energy usage of the three main buildings. The community said, "do you know how many committees' we've got? Fifteen. Do you know who the members are on all 15 of the committees? You are looking at them. We are not doing any more committees." So, there is not the capacity to even get involved. (Anonymous, 2017)

The importance of a community energy champion for the success of a renewable energy project was also emphasized by many participants. This role was essential to push forward despite obstacles and setbacks. The following three quotes reflect the importance of a community energy champion.

Quote 1:

> The work of implementing a renewable energy system can often fall onto the shoulders of one or two community members –the community energy champions. This requires a broad range of skills, and requires perseverance, as these projects often encounter numerous obstacles and can take years to accomplish. (Anonymous, 2017)

Quote 2:

> It is important to have a community energy champion. This person has an important role in ensuring support from the community, working with stakeholders, procuring the right technical experts, and pushing the project forward through obstacles and setbacks. It is not just a matter of training – the community energy champion needs to be passionate about the project. (Anonymous, 2017)

Quote 3:

> The capacity of the community is crucial. Having a champion in the community who can forge ahead under any circumstance is crucial. If you don't have that, you are not going to have a project. (Anonymous, 2017)

Training Opportunities

Participants also spoke of the importance of training. There are a variety of skills required for renewable energy project development, including project management, engineering, construction, and operations and maintenance.

Participants noted that there have been improvements in training for community energy champions over the past few years –though Lumos Energy's Catalyst 20/20 program. This is an interactive three-month program that connects First Nations, Métis, and Inuit Catalysts to a network of Indigenous and non-Indigenous Clean Energy Project Mentors and Coaching Specialists involved in clean energy project development. However, the program is focused on project management, and participants expressed that there was also a need for training for construction, and operations and maintenance.

There is also a need for training to be delivered using alternative teaching styles, such as training that is offered within the community, culturally appropriate, flexible and tailored to diverse learning styles. Currently, most training programs require community members to leave the community. This type of training is not well suited for everyone. One participant spoke of the success his community has had in creating small training programs within the community. Under this model, participants receive one-on-one attention and are not required to leave their family, friends, and community. They stated:

> The [government] wants to teach people how to do trades –it's called market-related training. What the province and the Feds do is say, "we have a shortage of carpenters, electricians, and trades people." … So, they allocate a bunch of money [to train First Nations in these fields] … Then they get people [in the training program] who are often struggling with life skills. These people [may] have been born and raised in a household where meals are not regular, where they have not succeeded in education, where getting up in the morning is not what they saw mom and dad do. So now, [in the education program, the expectation is] "8 AM everyone up, we will see you at the training centre, and you will pass." Then they don't pass. They go home, and they know they have failed, and we do that four or five times in that person's life from the time they are [age] 15 to 30.
>
> We set them up for failure, and then we blame them. …And discouragement sets in –in the trainers, in the administrators and more importantly in the students, and we keep repeating this. What we have done in [my community], is say… We're going to meet people where they are. So, if you have trouble getting up in the morning [you can start] at 10 AM instead of 9 AM or 8 AM…. We are having the students driving the training, and we have achieved success like we never have before. (Anonymous, 2017)

Participants also cautioned that although renewable energy projects create jobs, they often do not produce many permanent jobs. Depending on the energy source, short-term labor is usually needed for the project construction. Whereas, operations and maintenance and ongoing energy efficiency work may create one or two long-term jobs depending on the size of the community. However, in small remote communities the benefits of just one job can be significant, and having proper and consistent operations and maintenance is essential for reliable energy and the longevity of the system.

6.3.2. Trust

Consistent with literature findings, participants noted that trust is often an issue. There is a long history, which continues to this day, of BC Hydro disregarding the rights of First Nations. This has led to a tense and mistrusting relationship between BC Hydro and many First Nations communities. If BC Hydro does not begin upholding Indigenous land and treaty rights, it will continue to be difficult to build a positive government-to-government relationship.

Trust was also brought up as a barrier to energy efficiency work, as this work is done in homes. Several participants noted that community members often felt that it was intrusive to have a stranger from outside the community entering their homes.

6.3.3. Information Sharing

Participants noted that although there are mentorship programs, there has been a lack of knowledge sharing between communities. There are many insights and lessons learned from one community to the next and sharing that knowledge has immense potential to prevent communities from making the same mistakes and running into the same barriers. Several participants noted that community-to-community mentorship relationships have occurred organically, and non-profit organizations have also been successful in this space. One participant stated: “Mentorship may be one area where the [provincial and federal] government just needs to get out of the way.” (Anonymous, 2017)

6.4. Technical

6.4.1. BC Hydro Standards

BC Hydro has strict reliability standards in place that are essential for maintaining the electricity grid in BC. However, participants have suggested that applying these same standards to microgrids in remote communities is not necessary due to the size of the system. Participants expressed that BC Hydro is reluctant to deviate from these standards because of unfamiliarity with different technologies, as well as the optics of applying different standards to remote customers. However, this could be a missed opportunity. Creating flexibility around BC Hydro’s standards could allow for technology and services that are more appropriate for microgrids and could improve the functionality, efficiency, and cost.

Chapter 7. Discussion of Results

Table 8 provides a summary of the key barriers identified through the interviews and literature review.

Table 8: Summary of Barriers

Barrier	Description
Economic Viability of Renewable Energy	• The avoided cost of diesel used to calculate EPAs does not account for negative externalities of diesel • Interconnection requirements limit the amount of renewable energy that can be used.
Access to Capital	• The high cost of living in remote communities causes indebtedness and limits access to capital. • Government grant system is uncoordinated and complex.
Social Barriers	• Limited community capacity and competing priorities. • Trust and relationship building are ongoing issues; the federal and provincial governments, and utilities have a long history of disregarding First Nations rights.
Technical Barriers	• Inflexible BC Hydro standards can prevent communities from implementing technology that may have otherwise been beneficial.

7.1. Guiding Policy Objectives

The interview findings and literature review identified policy gaps and parameters for policy recommendations. Broadly speaking, the research findings indicated a need for the following changes.

Increasing the purchase price for renewable energy

Increasing EPA rates will ensure that projects in remote communities are economically viable, and will better recognize the social and environmental benefits of transitioning from diesel to renewable energy.

Training

There is a need for flexible, community-based training programs for O&M of diesel and renewable energy systems, energy literacy and conservation, and basic energy efficiency upgrades. Training will increase local employment and community's capacity to develop and operate energy projects.

Streamline Granting Process

Having a single point of contact within government and a more coordinated approach to providing funding would help ensure that grants are equitably allocated; overcoming barriers, such as small communities being over looked-for funding, and vendor-driven grant applications. Streamlining the grant process would also help shift the administrative burden from remote communities to the provincial and federal governments.

Flexible Financing for Energy Efficiency

Energy efficiency has the potential to reduce the many of adverse impacts associated with diesel use, such as reducing energy costs, pollution, and GHG emissions. Currently, energy efficiency incentives are available through rebates and the Energy Conservation and Assistance Program. Although these programs provide incentives for energy efficiency upgrades, they are limited in scope and do not offer the flexibility needed to meet the realities in remote communities. Additionally, rebates are often inaccessible to low-income customers, given that they are required to pay the upfront cost.

7.2. Jurisdictional Scan

The following table identifies policies used in other jurisdictions that meet the defined policy objectives. These policies provide a framework for developing policy options for this analysis. The appendices provide more information about each of these policy areas.

Table 9: Summary of Policies

Program	Description
Power Purchase Agreement Directive for Whitesand First Nation Biomass Project	Ministry of Energy Mines in Ontario provided a directive to the utility to include an adder to the EPA negotiated with Whitesand First Nations to account for the social benefits of their Biomass project which was being used to reduce diesel consumption. The directive stated, “The project will also have a number of benefits, including local job creation and reduced diesel use leading to reduced greenhouse gas emission.” The utility offered a base rate starting at $257/mWh in year one of commercial operation, with an addition of an Economic Development Adder of $184/MWh to account for the social and environmental benefits (Independent Electricity System Operators, 2015).
Pay as You Save (PAYS) Manitoba Hydro	Manitoba Hydro’s Pay as You Save (PAYS) on-bill financing program is used to finance energy efficiency upgrades in homes. Allowing households to invest in efficiency upgrades at no upfront cost, and paying for the upgrades through their monthly savings (Duffy & Beresford, 2016).
Manitoba Hydro and Aki Energy - Community Geothermal Program	Through Manitoba Hydro’s PAYS Community Geothermal Program Indigenous community members are engaged in being active participants in reducing their energy consumption. This is achieved through training local businesses on how to install and maintain geothermal heat pump systems while providing homeowners with convenient and affordable financing through PAYS Financing. Aki Energy, a non-profit social enterprise group, is the primary contact for Indigenous communities seeking to use the Community Geothermal Program. In addition to helping the communities identify opportunities for geothermal technology use, Aki Energy also trains community members on how to install and maintain these systems (AKI Energy, 2015).
INAC- Circuit Rider Water Trainer Program	INAC has implemented a Circuit Rider Training Program for water operators in First Nations communities. This is a long-term capacity building program that provides training and mentoring services to operators of First Nations water systems. Under this program qualified experts rotate through a circuit of First Nation communities, training the people responsible for the water operations. The trainers would rotate through the communities every three months for 3-4 days of training (Circuit Rider Trainer Professional Association, 2017).
The Alaska Energy Authority’s (AEA) Circuit Rider program	The Alaska Energy Authority’s (AEA) Circuit Rider program provides eligible utilities with technical assistance to improve the efficiency, safety, and reliability of their power systems and helps reduce the risk and severity of emergency conditions. AEA staff instructs the rural utility operators and managers in the proper operations and maintenance of their generation and distribution infrastructure. Generation includes conventional diesel and alternative sources of hydro and wind.
University of Sudbury’s Community Based Program	The University of Sudbury has been offering a community-based program since 2013. This program allows First Nations students to improve their education without having to relocate. Students can complete their coursework through face-to-face instruction and video conferencing (Hallmark & Reed, 2016).
Northwest Territories Single window Service Centres	The Government of the Northwest Territories (GNWT) established Single Window Service Centres. Each office is staffed with a Government Service Officer (many of whom speak Indigenous languages) who assist residents in small communities in accessing GNWT and Government of Canada programs and services (Government of Northwest Territories, 2017).

Chapter 8. Policy Options

The following chapter outlines policy options for reducing the barriers to displacing diesel in remote First Nations communities. The options are derived from the interview data, literature review, and examples from other jurisdictions. The options are not mutually exclusive; they are complementary and work together to address the multiple barriers that have been identified.

8.1. Policy Option 1: Electricity Purchase Price

Policy option 1 has two components, to account for the two subsidy structures. This policy option proposes increasing energy subsidies by (1) increasing EPA rates for communities who are part of BC Hydro's NIA and (2) increasing the 'Level of Service Standard Funding' for independent INAC subsidized communities.

8.1.1. Policy Option 1a: BC Hydro EPAs

This policy option proposes increasing the rate offered for EPAs, by including a shadow price for carbon of $50/tonne. It also recommends removing the turn-down provision in EPA agreements.

Table 10: Proposed EPA Rates

Status Quo EPA	Proposed EPA
Avoided cost of diesel (10-year historical cost) + capacity payment (where applicable)	Avoided cost of diesel (10-year historical cost) + capacity payment + price for carbon of $50/tonne

The economic viability of renewable energy projects will be improved by increasing EPA rates for renewable energy and removing the turn-down provision (see Appendix A for further discussion on EPAs). This could be achieved by including a shadow price of $50 a tonne for carbon and a capacity payment to account for the increased lifespan of the diesel generator and decreased O&M. The shadow price of $50 per tonne was chosen because it will be the federally mandated price for carbon in 2022.

Under this option, BC Hydro would also adjust their interconnection requirements for EPAs by removing their turn-down provision. This provision stipulates that diesel generators must run at an efficient rate; if the generator is not able to run efficiently, the renewable energy source will need to reduce generation. Under this option BC Hydro would resize diesel generators to fit the community's renewable energy system (if necessary), allowing maximum use of the clean energy source.

8.1.2. Policy Option 1b: INAC Subsidies

This policy option proposes increasing the amount of subsidized energy for INAC subsidized communities from 750 kWh to 1250 kWh.

As previously discussed, the Level of Service Standard policy determines the amount of subsidies communities receive from INAC. This subsidy is distributed as a lump sum, based on factors, such as fuel costs, population, number of houses and number of community buildings. If communities generate alternative energy or reduce energy demand, the money from this subsidy stays in the community as opposed to being spent on diesel fuel. Like an EPA, this subsidy acts as a revenue stream. If energy were subsidized at the same rate as BC Hydro communities, it would essentially be providing the 'avoided cost of diesel.'

This policy option proposes increasing the Level of Service Standard subsidy to a rate that was equivalent to BC Hydro rates. This will provide a stronger incentive for renewable energy and energy efficiency, and it would immediately help reduce the energy poverty in these communities.

8.2. Policy Option 2: Financing for Energy Efficiency

This policy option proposes creating an on-bill financing (OBF) program to provide accessible and flexible funding for energy efficiency upgrades in existing buildings.

Energy efficiency is an essential aspect of community energy management; it can significantly reduce diesel consumption and help residents to reduce their energy bills. It will also reduce the load required for a renewable system. Existing literature and interview data indicate that the most significant barrier to energy efficiency upgrades is the upfront cost.

On-bill financing allows Bands and households to invest in energy system upgrades at no upfront cost. The investment is financed through a loan, and repaid through a small addition to the utility bill, allowing households or communities to repay the loan over time. OBF can be designed in a way to ensure savings are greater than the cost of the loan, and on a shorter timeline than the life of the upgrade (Financing Solutions Working Group, 2014). There are several benefits of promoting energy efficiency through OBF programs:

- **Accessibility:** Many customers who are interested in energy efficiency upgrades are not eligible for conventional loans or may find them too expensive. With an on-bill financing loan, many of these customers have a low risk of defaulting on their payments because it will result in loss of utility services. Utilities can consider credit-worthiness factors – such as traditional cash flow analysis, credit scores, and on-time utility payment history –without undue default risk.

- **Split incentive:** Building owners are typically responsible for the costs of energy efficiency upgrades; however, the tenants incur the benefits from lower energy costs. This split incentive discourages the owner and tenants from investing in energy efficiency. On-bill financing can help overcome this barrier by enabling, building owners and tenants to agree to invest in improvements that yield a net reduction in the total monthly bill. (American Council for an Energy-Efficiency Economy, 2017)

- **Transferability:** Homeowners in urban centres often do not keep their homes for the 10-20 years required to pay off the energy efficiency upgrades through OBF. However, many OBF programs enable for transfer of the loans to new homeowners.

- **Functioning under the current utility system**: OBF programs can be combined with other utility-run incentives to enhance the affordability of energy efficiency upgrades. For example, with OBF and rebates bundled together, available rebates offset the amount to be repaid. Bundling also saves the customer the time of having to secure the rebate and financing separately.

OBF has been successfully implemented by utilities across Canada, including Nelson Hydro, Manitoba Hydro, and Nova Scotia Power, and BC Hydro and Fortis BC implemented a piloted an OBF program in 2012 (see Appendix B for details about OBF programs in other jurisdictions).

Through Manitoba Hydro's Pay as you Save (PAYS) OBF program they have partnered with Aki Energy –an Indigenous-owned social enterprise –to support First Nations in accessing financing. PAYS finances the upfront cost of equipment and installation for geothermal systems. The loans are recovered through an on-bill charge with repayment terms up to 20 years. Energy bill savings are greater than the financing charge so that participating First Nations households see energy bill savings from day one (Duffy & Beresford, 2016).

In addition to supporting energy efficiency improvements and cost savings, the program provides training and creates jobs. In the first year, Aki Energy trained 30 First Nation geothermal installers who completed 110 residential geothermal systems on Peguis First Nation and Fisher River Cree Nation. Families who received the new systems will cumulatively save about $44,000 per year in reduced utility costs (Duffy & Beresford, 2016).

8.3. Policy Option 3: Streamlining Funding

This policy option proposes streamlining the existing grants available to remote First Nations communities in BC.

Interview participants noted that uncoordinated grant timelines cause project delays, and the application requirements are unreasonable given the capacity of remote communities. Streamlining and simplifying the process would improve access to funding, and increase effectiveness and efficiency of the grant allocation process. However, logistically this is a complicated process. There are many different levels of government and ministries involved, and the scope and objectives of each program are different.

The Government of the Northwest Territories (GNWT) and the Government of Manitoba have implemented single window funding centres to address complex funding systems and streamline granting processes. In 2010, GNWT initiated a pilot project establishing Single window Service Centres. The service centres serve small communities in Northwest Territories (NWT) and each office is staffed with a Government Service Officer, many of whom speak an Indigenous language. Their job is to help residents of small communities' access GNWT and Government of Canada programs and services. Since its inception, the program has grown across the NWT from 8 to 20 Single window Service Centres (see Appendix C for further details about single window funding systems) (Government of Northwest Territories, 2017).

Manitoba has also created a single window portal for the intake, assessment and awarding of local government infrastructure grants. This was in response to long-standing complaints by local governments that granting has been historically inefficient, requiring multiple applications to multiple programs (Association of Manitoba Municipalities, 2016). The single window application model introduced a single intake for infrastructure funding for six different grant programs. The first intake under this model was in September 2017.

These examples provide a model for intake, assessment and awarding of energy grants for remote communities in BC. Under this model, communities would have a government representative who would be their single point of contact for accessing grants. Communities would be required to submit a single grant application for each phase of their energy project, as opposed to one for every grant. The applications would then be distributed internally to relevant funding programs.

8.4. Policy Option 4: Community-Based Training

This policy option proposes a community-based training program for energy system operators.

Interview participants and existing literature indicated that the limited capacity in remote communities often leads to outsourcing labour for energy project management, construction, and operations and maintenance –despite high levels of unemployment. Additionally, participants expressed that attending university is not suitable for everyone, and there is a need for alternative training models to accommodate this. They emphasized a need for community-based training programs, tailored to individual learning styles.

The Government of Canada has developed community-based training programs for water systems operators, and Alaska has a similar program for energy system operators. INAC’s Circuit Rider Training Program (CRTP) is a long-term capacity building program that provides training and mentoring services to operators of First Nations water systems. Program delivery varies based on Province; however, they are generally delivered by a local Indigenous organization and funded by INAC.

Similarly, the Alaska Energy Authority’s (AEA) has a circuit rider program, providing training and support to rural energy utilities in small communities with populations between 20 and 2,000. The program aims to improve the efficiency, safety, and reliability of their power systems –helping to reduce the risk and severity of emergency situations. AEA staff train rural utility operators and managers how to correctly operate and maintain their generation and distribution infrastructure. Training is available for conventional diesel generators and alternative energy. Technical specialists also provide support in diagnosing and troubleshooting through real-time remote monitoring, in addition to onsite training, technical consultation, assistance and minor repairs (Alaska Energy Authority, 2017).

The circuit rider training programs, outlined above, provide a model for this policy option. The proposed program would have qualified experts rotating through remote communities for three to five days every three to four months, providing support for:

- Developing and maintaining capacity to manage energy generation and distribution infrastructure
- Supporting energy conservation and efficiency measures
- Increasing reliability of systems
- Ensuring efficient operation and maintenance
- Maximizing the use of existing infrastructure
- Providing 24-hour access to qualified experts in case of emergencies

To recognize the expertise that exists regionally, funding would be provided for qualified local organizations to deliver training within their region or community.

Chapter 9. Criteria and Measures

The following section outlines the criteria that will guide the assessment of policy options. Criteria were developed based on interview findings, and literature findings. Table 11 provides an overview of how each objective is assessed and provides context for their inclusion in the analysis.

Table 11: Criteria and Measures

Societal Objective	Criteria	Measure
Effectiveness	Removes economic barriers for reducing diesel consumption through energy efficiency or renewable energy.	**High:** removes economic barriers that have prevented communities from implementing renewable energy and energy efficiency **Medium:** Removes economic barriers that caused delays in the process. **Low:** No impact.
Fairness, justice, and Equity	Reduction in energy bills	**High:** Direct impact reducing energy bills **Medium:** Indirect reducing of energy costs **Low:** No impact
Capacity Building	Skills development and employment opportunities	**High:** Direct impact increasing capacity **Medium:** Likelihood of increasing capacity **Low:** No Impact
Efficiency	Clarity and simplification of policy process	**High:** Significantly reduces the amount of work required for communities to implement renewable energy or energy efficiency **Medium:** Slightly reduces the amount of work required for communities to implement renewable energy or energy efficiency. **Low:** No impact
Government Management Objectives		
Budget impact	Marginal incremental cost of the policy option	**High:** No cost **Medium:** Minor costs **Low:** High costs
Administrative complexity	Number of departments involved, and changes required to process/program	**High:** Requires one or two ministries, and minor changes to existing programs **Medium:** Requires several ministries and moderate changes to the existing programs. **Low:** Requires multiple levels of government and ministries, and significant changes to existing programs.

9.1. Effectiveness

The first criterion measures the direct impact that each option has on the economics of energy efficiency or renewable energy projects. Policy options that directly improve the economic viability of a renewable energy or energy efficiency project will receive a high ranking, whereas those that do not impact the economics of a project will receive a low score. This criterion will be weighted three times more than the rest of the criteria; recognizing that economic viability of a project is a foundational element of project development.

9.2. Justice, Fairness, and Equity

This criterion measures the impact that each policy option will have on energy bills. Remote communities pay more per kWh for energy and often consume more energy due to inefficient houses, and cold climates. Reducing consumption and costs will help address energy poverty and contribute to economic reconciliation. Therefore, policy options that will have a direct impact on energy bill reduction will receive a high rating, whereas those that do not have an impact on energy costs will receive a low rating.

9.3. Capacity Building

This criterion measures each policy option's direct impact on skill development and capacity building in remote First Nations communities. Interview participants expressed that it was a priority to ensure that community members can take advantage of employment opportunities that were created through renewable energy and energy efficiency projects. Therefore, policy options that increase opportunities for skill development rank highly, and those that do not create these opportunities receive a low ranking.

9.4. Efficiency

One of the reoccurring interview themes was the complexity and inefficiency of current funding programs. This policy option measures the degree to which each policy option reduces the steps required for communities implementing renewable energy projects, and ease at which communities can communicate their needs through having fewer points of contact. Policy options that streamline the existing process receive a high ranking, whereas those that have no impact receive a low ranking.

9.5. Budget Impacts

This policy option will measure the incremental costs to the provincial and federal government of each policy option. Options that are costly will receive a low ranking; those that are low cost will receive a high ranking.

9.6. Administrative Complexity

Given that there are multiple levels of governments and ministries involved in supporting remote community energy. This option measures the complexity of implementing each policy. This criterion measures the number of organizations that must be directly involved in creating the given policy change, as well as the amount of change that is required to current policy/program. Policies that can be implemented by one or two ministries and require minor changes will receive a high rating, whereas those needing multiple levels of government and departments, and substantial program change will receive a low rating.

Chapter 10. Evaluation

In the following chapter, I provide an analysis of policy options for displacing diesel in remote communities. These policy options are evaluated based on the standardized criteria developed in Chapter 9. In conducting the analysis, I use my research findings and determine policy options' success on each criterion relative to the success of other options. Qualitative scores of high, medium and low are assigned through this process to illustrate the relative strengths and weaknesses of different policy approaches (summarized in Table 12)

10.1. Policy Option 1: Energy Purchase Price

10.1.1. Policy Option 1A: BC Hydro Energy Price

EPAs are an essential enabling policy for the development of clean energy for remote IPPs. The rate offered for EPAs determines the business case for renewable energy. Currently, the prices provided by BC Hydro and the inclusion of the turn-down provision have created an insurmountable barrier for some communities in implementing renewable energy. If the EPA rate was increased and the turn-down provision was removed there would be a stronger business case for renewable energy projects. One that is more reflective of the actual economic costs and benefits, and is closer to the socially optimal level of production. Furthermore, this policy can be easily administered by BC Hydro, with the approval of BCUC.

The limitations of this policy option are that it does not directly support skills development in remote communities. Another limitation is that this policy option would be costly for BC Hydro to administer. BC Hydro would be buying clean energy at a rate that is higher than the avoided cost of diesel because of the shadow price for carbon. However, when the federal Carbon Tax is increased in 2022, BC Hydro will be once again paying the displaced cost of diesel –therefore not incurring a loss. BC Hydro would also incur some incremental costs by changing their turn-down provision, as they would likely need to replace some of the existing diesel generators to accommodate renewable energy-diesel hybrid systems. Overall, this may lead to a minor rate increase for ratepayers.

10.1.2. Policy Option 1B: INAC Energy Price

Increasing the subsidies provided by INAC through the Level of Service Standard funding would have a substantial impact on equity, by reducing the energy rates paid by remote communities. This will reduce bills to a level that is comparable with BC Hydro's rates helping to reduce energy poverty, and the debt cycle that has been caused by chronic underfunding.

This option also increases the incentive for renewable energy and energy efficiency. This subsidy will become a revenue stream for communities with renewable energy projects, instead of being used to pay for diesel fuel. Like EPAs, these subsidies allow communities to receive the avoided cost of diesel for their renewable energy project. The policy is also easy to administer, as the subsidy is provided directly from INAC to First Nations Bands and there is no involvement from provincial ministries or utilities.

This policy option also has several shortcomings; it does not directly increase capacity development or training in remote communities. Furthermore, this would create incremental costs for the government.

10.2. Policy Option 2: Financing for Energy Efficiency

OBF would reduce a significant barrier to energy efficiency, by providing funding to overcome the upfront cost hurdle and allowing projects to be repaid over time. OBF could also help decrease energy costs for bands and households. With smart investments in energy efficiency, the savings can be greater than the costs, lowering energy bills. OBF can also be combined with existing grants and rebate programs to reduce the cost that must be repaid. Through Manitoba Hydro and AKI Energy's PAYS program, the Fisher River Cree Nation retrofitted 200 houses, and the bill reductions are about $1,000 per house per year, which amounts to $200,000 a year in bill reductions (Aki Energy, 2017).

Furthermore, OBF is a loan program, so it would be low cost and could be sustained long-term (when compared with a grant program). As loans are repaid, they could be recycled back into the program allowing more communities to benefit over an extended period.

OBF’s place on a utility bill may be a more reliable repayment source than other traditional financing products, such as unsecured loans or lease agreements. In their study of 30 OBF programs, Financing Solutions Working Group found that default rates ranged from 0–3%. (Financing Solutions Working Group, 2014)

Administratively, this program would be relatively easy to implement. BC Hydro has gained knowledge and experience of OBF, through their 2012 pilot program. However, there is the added complexity of creating two separate programs, one through BC Hydro and the other through INAC. For INAC, it would be slightly more complicated as they do not provide electricity or heating bills to First Nations, so this would involve First Nations transferring money back to INAC to repay these loans. INAC and BC Hydro would have to work with each First Nation to decide how OBF could be successfully designed and administered.

10.3. Policy Option 3: Streamlining Funding

This policy option has the benefit of reducing the capacity required for communities to apply for grants, and government to administer grants. Participants expressed that having numerous uncoordinated grants has created a complex grant system that is difficult to navigate, often leading to project delays. Streamlining existing policies would reduce project delays, provide communities easier access to incentives and likely accelerate the rate of renewable energy deployment.

This policy will also create a more intentional connection between government and communities, enabling the provincial and federal government to identify and overcome some of the funding pitfalls, such as vendor-driven applications, and larger communities being favored over smaller communities.

However, this policy option will not impact energy rates, nor will it increase capacity in remote communities. Administratively, this program would also be complicated to administer, as many different ministries are currently responsible for funding; presenting logistical and political challenges.

10.4. Policy Option 4: Training

A circuit rider training program would help build capacity in communities by providing a supportive training environment for participants to learn how to maintain and operate their existing system. The Circuit Rider Training program for water operators that this program is modeled off has been successful in lowering maintenance costs, reducing interruptions in service, reducing operator turnover, and increasing operator self-confidence and self-esteem.

Although this program has clear benefits for capacity and skill development, it will not have an impact on the development of renewable energy projects, nor will it reduce energy bills in remote communities. Furthermore, the program would be costly and complicated to administer. However, there may be the secondary benefit of cost savings through reduced O&M costs, fewer generator breakdowns, and an extended lifespan of the equipment.

Another shortcoming is that communities may not be receptive to having someone from outside of the community provide training. For the success of the program, trainers will need to have cultural sensitivity when entering communities and be skilled at relationship building. In the long-term, community members who have been through the training may be able to take over this role.

10.5. Discussion

The interview data identifies the need for a variety of policies to address the barriers faced by remote communities in implementing renewable energy systems. Table 12 depicts the outcomes of the analysis and the critical trade-off of each policy option. Each option has different strengths, and none satisfy all the criteria.

Table 12 Policy Option Comparison

Societal Objective	Criteria	Policy Options				
		BC Hydro EPA	INAC Electricity Rates	Energy Efficiency Incentives	Circuit Rider Training	Single window Funding
Effectiveness **weighted three times more*	Economic viability of an energy project	High 9	High 9	Medium 6	Low 3	High/ Medium 7.5
Fairness, Justice, and Equity	Reduction in energy bills	Medium 2	High 3	Medium 3	Low 1	Low 1
Capacity Building	Skill development and employment opportunities	Low 1	Low 1	Low 1	High 3	Medium 2
Efficiency	Clarity and simplification of policy process	Medium 2	Low 1	Medium 2	Medium 2	High 3
Government Objectives						
Budget Impact	Incremental costs	Low 1	Low 1	High 3	Medium 2	High 3
Administrative Complexity	Number of departments involved, and changes required to program/process	High 3	High 3	Low 1	Medium 2	Low 1
TOTAL		18	18	16	13	17.5

Chapter 11. Recommendation

The analysis demonstrates the relative strengths and trade-offs of each policy option. All the policy options performed relatively well, and are complementary because each policy option addresses a different barrier. Increasing EPA prices is the most effective policy for enabling renewable energy development, followed by creating a single window system to streamline and coordinate existing grants. The circuit rider training program and on-bill financing are less effective overall; however, they received a high ranking for capacity building and energy bill reduction, respectively.

Based on the outcome of the analysis, two policy packages are recommended. The packages have been prioritized based on their overall impact. The primary policy recommendations are intended to be implemented first; whereas, the secondary recommendations could be implemented on a longer timeline if necessary. For the success of these policies, program design and implementation should be done in partnership with remote First Nations governments.

11.1. Primary Policy Recommendation

11.1.1. Policy Recommendation 1: Increase Electricity Purchase Price

My primary recommendation is to increase the electricity purchase prices, and the Level of Service Standard subsidy to create a stronger economic case for renewable energy. EPA rates were expressed as the most prohibitive barrier to renewable energy projects. Increasing the price offered for EPAs will help recognize the social and environmental value of displacing diesel. This policy is foundational, because, without fair EPA prices, projects will not be economically viable and will not be developed regardless of other policies.

Likewise, increasing the Level of Service Standard subsidy will improve the economic viability of energy projects in INAC subsidized communities, while reducing energy poverty. Breaking the cycle of indebtedness will enable communities to more easily access the capital needed for project development.

11.1.2. Policy Recommendation 2: Streamlining Funding

Streamlining existing grants was almost unanimously recommended across interview participants. Increasing the coherence and coordination of the current system, and creating a stronger relationship between funders and communities will reduce project delays, enable communities to more easily access funding, and allow provincial and federal governments to more equitably and effectively allocate grants. Furthermore, having a single point of contact for community energy projects, will reduce duplication and inconsistencies, and create continuous support from project conception to construction.

11.2. Secondary Policy Recommendation

OBF and circuit rider training would also be beneficial policies; however, they have been recommended as a secondary package because they are narrower in scope and have less of an overall impact.

11.2.1. Policy Recommendation 3: On-bill Financing

OBF is a low-cost policy, to create long-term maintainable financing for energy efficiency retrofits, which could also be used with existing incentives. However, accessing capital for energy efficiency upgrades was not the most prohibitive barrier; thus, is not the most pressing priority and could be implemented on an extended timeline.

11.2.2. Policy Recommendation 4: Circuit Rider Training

A circuit rider training program would provide valuable opportunities for training and capacity building in remote communities. This would help ensure that communities can maximize local employment and keep more dollars and job in the community. The success of this program would depend on having community buy-in, and trainers that are skilled at relationship building. However, formal and informal training programs are increasingly being delivered by private and non-profit sectors. Thus, there is a risk of redundancies and duplication.

Chapter 12. Conclusion

As renewable energy costs decrease worldwide, the economic, social and environmental case for transitioning away from fossil fuels, and toward a greater reliance on more local and sustainable forms of energy is increasingly compelling. Diesel generators produce GHG emissions, cause adverse health impacts, and provide expensive energy.

Many First Nations within BC are committed to abandoning diesel but are coming up against insurmountable barriers as they work toward this objective. The policy landscape for remote community energy is increasingly complex and uncoordinated, and new policies are failing to fill existing policy gaps. As one interview participant said, “it’s like the left-hand doesn’t know what the right hand is doing.”

Federal and provincial governments have the opportunity to work towards reconciliation by supporting First Nations communities developing their own path towards energy security and autonomy. Well-designed flexible policies and programs can help to accelerate the development of clean energy systems.

12.1. Limitations

There are several limitations of this research that should be considered when interpreting its findings. First, there is limited data on remote community energy, and very little research conducted on the policy options that have been successfully implemented in other jurisdictions. This created limitations, in identifying successful policy options and accurately analyzing their potential impact. Most of the options have either not been implemented in remote communities or for energy infrastructure. Therefore, there is limited data proving the success of each approach in the given context.

Secondly, the scope of this analysis was quite broad and touches on literature from many different policy areas –from utility rate design to Indigenous capacity development policy. Given that the policy area is complex, and piecemeal I felt it was essential to take a holistic approach rather than focusing in on one area. However, each of these policy options could be a thesis topic on their own, which limited the depth of study. Further research into each policy area could provide insight on policy design, implementation, and alternative approaches.

Finally, as was noted throughout the report, my approach focused on provincial and federal government policies. First Nations within BC have increasing momentum, skills, and interest in the renewable energy industry. This could lead to more transformative Indigenous-led policy solutions for off-grid (and grid connected) communities. Policy makers should be continuously engaging with First Nations governments to explore alternative policy solutions.

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Appendix A: Electricity Purchase Agreements

In Canada, most electricity purchase prices are based on the avoided cost of diesel –a measure of what it would cost the grid to generate the electricity that is displaced by a new generation project (U.S. Energy Information Administration, 2017). Using this methodology, the electricity purchase rate is approximately $0.30/ kWh in remote communities in Canada (Lovekin, Dronkers, & Thibault, 2016). The levelized cost of energy (LCOE) is another methodology used to calculate the cost of diesel generation; this represents the per-kWh cost (in discounted real dollars) of building and operating a generating plant over an assumed financial life cycle. Key inputs of LCOE include capital costs, fuel costs, fixed and variable operations and maintenance costs, financing costs, and an assumed utilization rate for each plant type (U.S. Energy Information Administration, 2017).

There is no consistent methodology for calculating the avoided cost of diesel, for example, some utilities include transportation and operations and maintenance costs, and others do not. Certain provinces have also included 'adders' to the avoided cost of diesel to account for the social or environmental benefits of clean energy projects. Despite this, the avoided cost of diesel for remote community energy projects is often insufficient to make projects economically viable. The following section provides a discussion of remote community EPA rates and policies in other jurisdictions in Canada.

Jurisdictional Scan

BC

BC Hydro negotiates each remote community EPA confidentially using the avoided cost of diesel. The avoided cost of diesel includes the cost of fuel, transportation costs, and an adder for decreased maintenance and differed capital costs, only if the project displaces 100% of the diesel consumption). However, there is little transparency about how this rate is calculated, and project developers have raised concerns that the cost of diesel is being underestimated.

Ontario

In 2012, Hydro One Remote Communities Inc. (a subsidiary of Hydro One) implemented the Renewable Energy Innovation Diesel Emission Reduction (REINDEER) program (IESO, 2015). This program enables the connection of renewable energy projects to reduce the impact of diesel use on the environment. There are two types of REINDEER projects, receiving different rates: (1) “Standalone” projects get paid the avoided cost of fuel for electricity production; (2) “Net Metering” projects receive a reduced monthly bill and credits during times of overproduction (IESO, 2015). According to Lovekin, Dronkers, and Thibault (2016), the Ontario REINDEER program offers some of highest rates in Canada – the average is around $0.41 / kWh. (IESO, 2015).

Ontario - Whitesand First Nation

In Ontario, the Ministry of Energy Mines provided a directive to the local utility to account for the social benefits in calculating the EPA for Whitesand First Nations' Biomass project. The directive recognizes the numerous economic, social and environmental benefits of the project stating:

> Due to the size of the existing diesel generators that service Whitesand First Nation, new homes and infrastructures are not able to connect, limiting economic development opportunities. The project, which is currently in the feasibility stages, will supply both the community electricity demand as well as the electricity required for the operation of the pellet facility. Once developed, the project will support Ontario's goal of encouraging Aboriginal community participation in the energy sector. The project will also have a number of benefits, including local job creation and reduced diesel use leading to reduces greenhouse gas emission. (Independent Electricity System Operators, 2015)

The directive then establishes an adder to account for the economic development benefits, stating:

> A base rate starting at $257/mWh in year one of commercial operation (the “Base Rate”) to be paid for all of the electricity generated by the Biomass Facility to service community demand;
>
> In addition to the prevailing Base Rate, the [power purchase agreement] shall provide for a fixed Economic Development Adder of $184/MWh. Together, the Base Rate and the Economic Development Adder shall form the “Pellet Demand Rate” to be paid for all the electricity generated by the Biomass Facility to service the pellet plant demand.” (Independent Electricity System Operators, 2015)

Northwest Territories

Northwest Territories Power Corporation has signed one EPA contract with Lutselk'e for their solar PV project. This EPA rate is reported to be based on the avoided cost of diesel with a 5% "top-up," acknowledging the reduced costs for operating and maintaining the diesel generator (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015).

Yukon

Yukon has four isolated diesel communities –Old Crow, Beaver Creek, Destruction Bay/Burwash Landing and Swift River –the EPAs for each are to be determined on a case-by-case basis, requiring approval from the Yukon Utilities Board (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015). According to project developers, a standard pricing mechanism, where IPPs are guaranteed a known price over time for the power they sell, would likely accelerate renewable energy uptake in these smaller communities (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015).

Hydro-Quebec

In Quebec, the Innavik hydro project has faced barriers in reaching an agreement with Hydro Quebec (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015). According to the Innavik hydro project developers, one of the barriers faced in the development of the hydro project was the lack of a transparent EPA mechanism (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015). In this case, "Hydro-Québec, offered to purchase power at the avoided cost of generation that represented only 40% of the total cost of service. This was insufficient to make the Innavik hydro project viable. Hydro-Québec claimed to have valued the avoided maintenance cost and the deferred capital investment in calculating its marginal cost of diesel generation. However, the details of the calculations were not disclosed raising suspicion that Hydro-Québec had undervalued the avoided cost of diesel generation (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015). The developers emphasized that transparent pricing mechanism would encourage developers and communities to take the financial risks required to develop renewable energy projects (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015).

Discussion

Project developers in remote communities have found that the avoided cost of diesel alone is not sufficient to make renewable energy projects economically viable.

Current rates are not enough to attract private financing to projects, especially considering the challenges and complexities of developing projects in harsh and remote regions (Lovekin, Dronkers, & Thibault, 2016). The avoided cost of diesel methodology serves as a starting point for further policy development to support remote community energy. Looking forward, setting prices requires innovative thinking and financial support from federal ministries in collaboration with territorial and provincial governments and utilities. Some innovative models could include:

- Pricing carbon pollution associated with diesel fuel combustion
- Recognizing social costs and benefits (using Levelized Cost of Energy for making investment decisions)

Furthermore, no common formula currently exists to calculate the avoided cost of diesel electricity that is consistent across Canada. Creating a formula based upon all the cost reductions, external expenses, and impacts (such as carbon emission and local air pollution), would be beneficial when utilities and clean energy developers are negotiating power pricing contracts (Cherniak, Dufresne, Keyte, Mallett, & Schott, 2015).

Appendix B: On-Bill Financing

On-bill financing (OBF) is usually provided by a utility for energy efficiency upgrades to residential or commercial units. The utility finances the upgrades and recovers the costs through repayment on the billing system. OBF has been implemented in dozens of jurisdictions around North America, below, several examples are highlighted.

Jurisdictional Scan

Manitoba

Manitoba Hydro implemented their first OBF program 15 years ago. They have since provided more than $317 million to over 75,000 participants. Manitoba's newest OBF Pay as You Save (PAYS) program provides transferable loans to residential customers (Energy and Mines Ministers' Conference , 2016).

As part of the PAYS program, Manitoba Hydro has partnered with Aki Energy – an Indigenous-owned social enterprise –to support First Nations in accessing financing. PAYS finances the upfront cost of equipment and installation for geothermal systems, recovering the financing through an on-bill charge with repayment terms up to 20 years (Aki Energy, 2017). Energy bill savings are greater than the financing charge so that participating First Nations households see energy bill savings from day one (Duffy & Beresford, 2016).

This program supports First Nations in improving energy efficiency, as well as building capacity within communities and creating jobs. In the first year, Aki Energy trained 30 First Nation geothermal installers who completed 110 residential geothermal systems on Peguis First Nation and Fisher River Cree Nation (Affordable Energy Canada, 2012). Families who received the new systems will cumulatively save about $44,000 per year in reduced utility costs (Duffy & Beresford, 2016).

Nova Scotia

Nova Scotia Power offers financing for heat pumps installed by their approved contractors. The terms vary from three to ten years, and the financing covers the cost of the entire installation. The interest rates vary from 4.9% to 6.9% depending on the loan amortization period. The repayments are made through the utility bill, and the loans are transferable if the house is sold before the loan has been fully repaid. Loans can also be paid back in full at any point to terminate the participation in the program. (Energy and Mines Ministers' Conference , 2016).

British Columbia

British Columbia launched two OBF pilot programs in November 2012, one in the City of Colwood, near Victoria, and the other the Regional District of Okanagan-Similkameen. The programs were designed to finance energy efficiency improvements in residential homes through a loan from BC Hydro in Colwood, and Fortis BC in the South Okanagan (Efe, Raheem, Wan, & Williamson, 2015). An extensive range upgrades were eligible for financing, including insulation, air source heat pumps, solar hot water heaters, weatherization improvements, and windows and/or door replacements (Efe, Raheem, Wan, & Williamson, 2015). Loans from $2,000 to $10,000 were available, and interest rates were determined as a function of the loan amortization period (Efe, Raheem, Wan, & Williamson, 2015). Neither program required bill neutrality; therefore, participants' bills may have increased because of the program.

The program was ultimately unsuccessful, due to low participation. However, according to reports by Pacific Institute for Climate Solutions and the Columbia Institute, BC's OBF pilot program failed because of problems in program design, lack of marketing and promotion, and resistance to administering these programs by the utilities (Duffy & Beresford, 2016; and Efe, Raheem, Wan, & Williamson, 2015)

Nelson, BC

Nelson, BC's EcoSave is an OBF program offered through the City's municipally owned electrical utility. The program was started as a pilot program in 2012 and in 2014 was renewed as a local bylaw (Duffy & Beresford, 2016). The two-year pilot program funded improvements such as improved insulation, reduced air leakage, and the installation of more efficient space and water heating systems (Duffy & Beresford, 2016). The pilot was partially funded by Fortis BC, Natural Resources Canada, and the Columbia Basin Trust (Duffy & Beresford, 2016).

A maximum of $16,000 is available over a five or 10-year term at a 3.5 percent fixed interest rate. A $100 processing fee is charged for every participant who accesses a loan (Duffy & Beresford, 2016). Unlike other OBF programs, the loan is non-transferable and must be paid off with the sale of the house (Duffy & Beresford, 2016).

Personal information –such as income or credit details– is not needed to access the loan because the loan is based on payment history and property verification (Duffy & Beresford, 2016). Therefore, the application process is efficient and easy to access. If the participants default on their payments, the OBF charge is subject to normal utility collection procedures, including disconnection of service and the addition of unsettled payments to property tax (Duffy & Beresford, 2016).

The average energy reduction for participants in the pilot was 35 percent, slightly higher than the initial program target of 30 percent (Duffy & Beresford, 2016). The post-retrofit assessment was completed by 107 participants, and the findings indicated a total annual energy savings of 5,837 GJ –reducing annual energy costs by $72,896 and GHG's by 260 tCO2e (Duffy & Beresford, 2016).

South Carolina

Help My House is an OBF program operated by rural electric cooperatives (co-ops) in South Carolina. The program offers low-cost financing for energy efficiency improvements repaid through the electricity bill. Help My House recognizes the distinct challenges and opportunities that rural communities face. The program was designed to help residents save energy, cut household utility bills, and reduce GHGs, all while supporting high-skilled jobs and keeping more dollars in the local economy (Keegan, 2013).

South Carolina rural communities have a comparatively high proportion of older, less efficient homes and low-income residents (Keegan, 2013). Homes generally have poor insulation and weatherization; often relying on electric resistance heating, which is particularly inefficient and costly (Keegan, 2013). Some households spend over 70 percent of their income on energy during peak heating and cooling months. Retrofitting these homes is one of the simplest and most cost-effective opportunities to reduce energy in the state (Keegan, 2013).

Rural residents –especially those who are low-income– often face barriers to accessing financing for energy efficiency upgrades. Many residents would not qualify for conventional loans, and renters' only option is to approach their landlords. Therefore, they are not able to reduce energy consumption and costs and increase the comfort of their homes (Keegan, 2013).

The Help My House program allows loans to be repaid over ten years or less, at 2.5 percent interest (Environmental Protection Agency, 2017). The program also requires overall energy bill reduction. Approximately one-third of the energy savings for each home is put towards lowering the monthly electric bill, while two-thirds are put towards repaying the loan (Keegan, 2013). The loan is also transferable if the home is sold or the renters move.

Another innovative feature of the program is that the co-op can identify homes to receive energy audits, rather than waiting for participants to self-select (Keegan, 2013). This enables the co-op to choose the most cost-effective saving measures of the homes within the community. Based on the results of the audits co-op staff can procure services from qualified contractors to perform efficiency improvements.

In 2011 and 2012, the Help My House pilot had 125 participating homes and produced promising results. Participants saw 34 percent reduction in their energy bills on average, resulting in savings of $288 per home per year after loan payments (Environmental Protection Agency, 2017). The U.S. Department of Agriculture and the South Carolina co-op funds provided the loan capital for the pilot program.

Discussion

In North America, there are many OBF programs with varying levels of success. This can generally be attributed to the circumstances of the jurisdiction, the utility carrying out the financing, and –perhaps most importantly– program design and communications (Efe, Raheem, Wan, & Williamson, 2015). OBF has been found to be most effective when energy cost savings are realized immediately, the interest rate is competitive, the process is streamlined, and the administrative burden for participants is low (Energy and Mines Ministers' Conference , 2016).

Table B. Jurisdictions in North America with OBF Programs

Country	State/Province	Name of OBF Program
Canada	BC	BC Pilot Programs –LiveSmart BC (Colwood and Okanagan)
Canada	BC	Nelson Hydro - EcoSave
Canada	Manitoba	Manitoba Hydro Power Smart Residential Loan Program, and Pay as You Save (PAYS) Financing
Canada	Nova Scotia	Nova Scotia Power's Heat Pump Program
US	Tennessee	Tennessee Valley Authority Energy Right Solutions Heat Pump and In-Home Energy Evaluation On-Bill Program
US	California	California On-Bill Financing & On-Bill Repayment Pilots
US	Georgia	Georgia Environmental Finance Authority—Residential Energy Efficiency On-Bill Loan Programs
US	Kansas	How$mart On-bill Program
US	New York	New York State Energy Research and Development Authority Green Jobs-Green New York On-Bill Recovery Program
US	South Carolina	Central Electric Power Cooperative "Help My House" On-Bill Pilot Program
US	Connecticut	Connecticut Small Business Energy Advantage On-Bill Loan Program
US	Wisconsin	Alliant Energy Shared Savings Wisconsin: On-Bill Program
US	New Jersey	SAVEGREEN On-Bill Repayment Program
US	Oregon	Clean Energy Works
US	Oregon	Mpower
US	New Jersey	PSE&G
US	Windsor	Windsor Efficiency PAYS
US	Hawaii	On-bill financing
US	Hawaii	Solar Saver Program
US	South Carolina	Help My House Pilot
US	New Jersey	Save Green Project

Source: 4 (Efe, Raheem, Wan, & Williamson, 2015)

Appendix C: Streamlining Grants

Single window systems refer to the streamlining of government application processes. Many countries have found that a single window system can greatly improve the allocation of resources and information flows between communities and government (Tsen, 2011). Several provinces and territories have successfully implemented a single window system for the distribution of grant funding, outlined in the following section (Tsen, 2011).

Jurisdictional Scan

Manitoba

Manitoba has developed a single portal for intake, assessment, and awarding of infrastructure grants for local governments This was in response to long-standing complaints by local governments that, "granting has been historically inefficient, requiring multiple applications to multiple programs, while conditional grants limited how money could be used" (Association of Manitoba Municipalities, 2016).

The single window system introduced a single intake for six different infrastructure funding program, including Neighbourhoods Alive! Community Initiatives, Neighbourhoods Alive! Neighbourhood Renewal Fund, Community Places, Community Planning Assistance, Hometown Manitoba, and Partner 4 Growth (Association of Manitoba Municipalities, 2016). The first intake with the new system was completed in September 2017.

Northwest Territories

In 2010, the Government of the Northwest Territories (GNWT) initiated a pilot project establishing Single Window Service Centres. These service centres are located in small communities in NWT. Each office is staffed with Government Service Officers, many of whom speak an Indigenous language. Their job is to help residents of small communities' access GNWT and Government of Canada programs and services.

The Single Window Service Centre model has received recognition for its innovative management, receiving the bronze medal from the Institute of Public

Administration /Deloitte Public Sector Leadership Award in 2014 (Government of Northwest Territories, 2017). This program is the first of its kind in Canada, and its success is rooted in respecting the traditional and cultural needs of residents. The program has grown across the Northwest Territories from 8 to 20 Single Window Service Centres since its implementation (Government of Northwest Territories, 2017).

Canada

In 2000, the Government of Canada committed to providing provincial and territorial governments with incremental funding to improve their early childhood education programs (Greenwood, 2005). A key component of the strategy was the commitment to explore a single window approach to funding early learning and child care programs for Indigenous children and their families (Canada's Public Policy Forum, 2015).

A single window pilot project was launched in 17 First Nations and Inuit communities. However, there were concerns that this program would result in decreased overall funding, and would reduce access to certain groups. Furthermore, the program faced challenges integrating programming and funding across federal departments and was ultimately discontinued. (Canada's Public Policy Forum, 2014).

Appendix D: Circuit Rider Training Program

Providing training within communities can help build capacity and job creation while supporting the cultural and traditional needs of Indigenous communities. There are several examples training programs within communities that have been implemented in North America, most notably the Circuit Rider Training Programs for Water Operators, and Alaska Energy Authority's Circuit Rider System for Energy Operators.

Jurisdictional Scan

Canada

The Circuit Rider Training Program (CRTP) is modeled after a highly successful training program carried out in Saskatchewan, by the Saskatchewan Water Corporation in the 1980's. The program was expanded in 1992, after determining that a training program would be required for the new water and wastewater treatment plants that were being constructed in First Nations communities across Canada (Circuit Rider Trainer Professional Association, 2017).

In 1994, a two-year pilot project was implemented in Ontario with funding from Health Canada and facilitated by the Assembly of First Nations in Ottawa. Following the pilot, the program was implemented in Ontario, in 1996, by the Ontario First Nations Technical Services Corporation. In 1997, the program was extended to Manitoba, facilitated by West Region Tribal Council and has since spread to all other INAC regions (Circuit Rider Trainer Professional Association, 2017).

Under this program, a trained operator and trainer visits a reserve and provides hands-on training to the facility operator on operations and maintenance of water systems. The trainer visits each community for three to five days, every three to four months. The program is voluntary and requires First Nations to request the service (Circuit Rider Trainer Professional Association, 2017).

The program is usually delivered by a First Nation organization or another local organization who is qualified to do so. For example, in Saskatchewan, the Saskatchewan Water Corporation provides training; in Manitoba, INAC funds one of the tribal councils to provide the CRTP; and in Ontario, the Ontario First Nation Technical

Services Corporation delivers the training (Circuit Rider Trainer Professional Association, 2017).

Depending on the skill level of the operator and the complexity of the plant, it can take up to two years to complete the training, because of the intermittent nature of the program (Circuit Rider Trainer Professional Association, 2017). Once operators have completed basic training, they can also pursue a provincial certification. According, to the Circuit Rider Training Professional Association, trainers are responsible for the following duties:

- To deliver “Hands-on-training” of plant operators in the proper operation/maintenance of water/wastewater treatment plants.
- To select and adapt technical material/training modules which would apply to each water/wastewater treatment plant operator’s facility.
- To teach plant operators (in a hands-on context) on how to troubleshoot mechanical/electrical and safety equipment.
- To provide training reports on site visits, observations, plant deficiencies, operator training, and recommendations.
- To submit training reports, etc. and training plan schedules every three weeks.
- To complete dacum charts to monitor the progress of the training modules at each year-end.
- To provide any on-site immediate repair and maintenance assistance to plant operators
- To develop proactive preventative operations/maintenance initiatives, including developing and implementing an MMP.
- To assist the operator and the First Nation’s Public Works Manager in the development of annual operations and maintenance budgets (with presentations to Chief and Council if required) for the water and wastewater systems.
- To assist operator to identify and rectify monitoring deficiencies (as per INAC’s Protocol for Safe Drinking Water in First Nations Communities)
- To participate in provision of 24/7 technical support to First Nations as required
- To provide summary of quarterly training reports, deficiency lists, etc. to the coordinator of CRTP (Circuit Rider Trainer Professional Association, 2017)

Alaska

The Alaska Energy Authority (AEA) is an independent and public corporation of the State of Alaska created by the Alaska Legislature in 1976.“The purpose of the Authority is to promote, develop, and advance the general prosperity and economic welfare of the people of the state by providing a means of financing and operating power projects and facilities that recover and use waste energy” (Alaska Energy Authority, 2017).

In contrast to BC, Alaska's energy system is made up of small energy co-ops, with over 200 isolated microgrids predominantly powered by diesel fuel. AEA runs three in-class training programs, ranging from three to eight weeks in length, including Power Plant Operator course, Advanced Power Plant Operator course, and Bulk Fuel Operator course (Alaska Energy Authority, 2017).

The Alaska Energy Authority's (AEA) Circuit Rider program also provides training and support to eligible rural utilities with populations between 20 and 2,000 (Alaska Energy Authority, 2017). The program aims to improve the efficiency, safety, and reliability of their power systems –helping to reduce the risk and severity of emergency conditions. AEA staff train rural utility operators and managers to correctly operate and maintain their generation and distribution infrastructure (Alaska Energy Authority, 2017). Training is available for conventional diesel generators and alternative energy, including hydro and wind.

Technical specialists also provide support in diagnosing and troubleshooting through real-time remote monitoring; and onsite training, technical consultation, and assistance for minor repairs (Alaska Energy Authority, 2017). The program is not a substitute for the utility's operations and maintenance budget and does not provide funding for major repairs or reconstruction of utility systems (Alaska Energy Authority, 2017).

AEA annually evaluates the needs of each utility under the Circuit Rider program. The needs and requests are reviewed with other information, and the program training is allocated to each community accordingly (Alaska Energy Authority, 2017). The AEA encourages utilities to have power plant operators with knowledge of the local power system; effective communication skills; availability during onsite visits; and the ability to maintain written performance logs (Alaska Energy Authority, 2017). Utilities are also encouraged to seek assistance through email and phone calls and have a remotely accessible Supervisory Control and Data Acquisition (SCADA) system, to reduce the program costs (Alaska Energy Authority, 2017). Current funding for the program is provided by the State of Alaska and Denali Commission.

Ontario

Similarly, the University of Sudbury has been offering a community-based program since 2013 (Hallmark & Reed, 2016). This program enables First Nations students to work to improve their education without having to relocate. Students complete their coursework from their communities through face-to-face instruction and video conferencing (Hallmark & Reed, 2016).

The program was initiated by Indigenous community members, including some instructors, that had been working at the university and seeking to bring education back to their community. Four women made up the first cohort. The program has since doubled in size with 8 students expected to graduate in 2017 and 14 students expected to graduate in 2018 (Hallmark & Reed, 2016).

Graduates from the program have shared that being able to access education in their communities allowed them to balance their school and personal commitments – many of the students had families and were also working (Hallmark & Reed, 2016). Students also found flexible scheduling allowed for participation in community commitments, and traditional and cultural events (Hallmark & Reed, 2016). The greatest advantage shared by the students was that the curriculum was relevant to their local community, focusing on their history and their traditions (Hallmark & Reed, 2016).