Skeena Watershed
Conservation Coalition

EMPOWERED ENERGY SOLUTIONS

Regional Energy Plan

February 2023

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EMPOWERED ENERGY SOLUTIONS TEAM

S W C C

Skeena Watershed Conservation Coalition's (SWCC) work focuses on the conditions for change at a community level in our watershed. Each year, SWCC delivers an ongoing schedule of activities that support the development of future leaders, collaborates with elected leaders, creates sustainable employment opportunities and collaborates with community economic development practitioners. Renewable Energy and energy use are very important topics in the Upper Skeena as a key component to a healthy ecosystem and community in the future. This approach earned SWCC the recognition as one of the top ten most effective and innovative organizations in Canada – twice!

URBAN SYSTEMS

SWCC partnered with Urban Systems for their breadth and depth of expertise in supporting the development and implementation of renewable energy projects, community energy plans, and greenhouse gas emissions management strategies for Indigenous, provincial, and local government clients.

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DEFINITIONS AND ABBREVIATIONS

The subsequent section introduces common terms used throughout the Plan.

Emission Factor (tCO_2e/MWh)

An emissions factor is a value which relates the quantity of a pollutant released into the atmosphere as a result of fuel combustion.

Carbon dioxide equivalent (CO_2e)

Carbon dioxide equivalent is a measurement of a greenhouse gas and how much global warming it may cause when emitted, using the equivalent amount or concentration of CO2 as the reference.

Community-owned Buildings

A community property that is owned and managed by the community or by a community-owned business or organization.

Greenhouse Gases (GHG) Emissions

Gases that trap heat in the atmosphere are called greenhouse gases. There are human and natural sources of greenhouse gas emitters. However, 97% of scientists agree that it is extremely likely that human activities account for an increase in greenhouse gases in the atmosphere over the last 150 years.

Kilowatt-hours (kWh)

A kilowatt-hour is a measurement of electrical energy, equivalent to a power consumption of 1,000 watts for 1 hour.

Megawatt (MW)

A megawatt is a unit of power equal to one million watts.

Net Present Cost

Net present cost is a financial indicator used by HOMER PRO software. It represents the overall cost associated with the project over the project life.

Net Present Value

Net present value is a financial indicator that demonstrates the difference between the present value of cash inflows and the present value of cash outflows over a period.

Photovoltaic (PV)

Zelating to the production of electric current at the junction of two substances exposed to light. PV systems are used to convert sunlight into electricity.

Power (kW)

Power is the rate at which energy is generated or used. The kW is a unit of power.

Residential Buildings

A residential building is a building used for dwelling or living purposes. This can include the following building types:

- Single-family home
- Multi-family home
- Co-op
- Townhouse
- Condominium

Setting Targets

Targets can help reduce a community's energy footprint. Targets can be in the form of:

- Intensity (Gigajoules per m2 or GJ/m2. This is a measurement of how much energy is used per m2 of a building)
- Absolute (Tonnes of carbon dioxide equivalent or tCO2e. This is a measurement of the total carbon emissions in a building or community as a result of energy use.)
- Overall
- Sector specific

An overall target refers to the overall energy and/or emissions from the community whereas sector specific refers to a sector. Sectors can include buildings, waste, and transportation. For the purposes on this Plan, only energy from buildings were reviewed.

Simple Payback Period

The simple payback period is the length of time required to recover the cost of an investment.

Watt (W)

The watt is a unit of power. It is derived as a unit of 1 joule per second and is used to quantify the rate of energy transfer.

Wilp

A Wilp (house) is a distinct House Group of the Gitxsan Nation. Madii Lii is one of two territories of Wilp Luutkudziiwus.

EXECUTIVE SUMMARY

The Empowered Energy Solutions project evolved from diverse conversations with the communities and residents of the Kispiox Valley, Anspayaxw, Sik E Dakh, and the traditional unceded territory of Wilp Luutkudziiwus about their current energy use, energy costs and energy sustainability in the region. Through these discussions, we learned about the regional challenges related to energy costs, energy security and sustainability experienced at the community and household level.

More specifically, a common thread emerged throughout the region – the amount being spent on electricity and, in some areas, diesel and other fossil fuels, were often crippling to communities and members. In fact, some community members and residents are confronted with the decision of paying a BC Hydro bill to keep the lights on, or buying groceries.

To fully understand the energy issues faced, different categories of energy users were selected to inform the research. Participants selected are a cross section of different energy users in the region based on what type of power they used (on BC Hydro grid or off grid) and scale (industrial use, residential or community usage). All participants live in a rural area and struggle with energy security and sustainability issues.

These conversations confirmed the need to invest in affordable, clean energy solutions in these communities, and it also confirmed that a regional energy plan is needed to guide and achieve this important, regional outcome.

As such, the main objectives of this project included building energy literacy and regional capacity in the clean energy sector. This involved working as a collective to help save communities and residents money on their energy costs, while reducing greenhouse gas emissions and improving regional energy security.

With these project goals in mind, the following four phased approach was used to advance the project:

1. **Develop a regional energy use and emissions baseline**
   - Understand existing energy use (from both electricity and fossil fuels) in the communities
   - Create a greenhouse gas emissions baseline from energy usage and quantify climate change impacts
2. **Identify energy efficiency retrofits and upgrades for homes and community buildings**
   - Identify various energy efficiency retrofits and potential upgrades, specific to various home and building types throughout the region
3. **Assess potential clean energy opportunities**
   - Complete an analysis of potential renewable energy technologies which may be suitable for development in the Kispiox Valley, Anspayaxw, Sik E Dakh and the Traditional Territory of Luutkudziiwus
4. **Complete the Empowered Energy Solutions Regional Energy Plan**
   - Draft the Regional Energy Plan to advance community specific actions and goals related to energy sustainability, energy cost savings and regional energy security.

Each community and the collective region will have a strategy (or action plan), presented through individual case studies, that helps each participant in the project to:

- Support a more sustainable energy future
- Enhance regional energy security and reliability
- Create opportunities for new and green employment and economic development initiatives.

These strategies are intended to support project participants in achieving their energy goals and objectives, reducing energy costs, and providing more sustainable energy solutions appropriate for the region. SWCC has partnered with Urban Systems for this project.

INTRODUCTION

Gitxsan Territory in northwestern British Columbia includes the beautiful Upper Skeena region, where the health and wellbeing of the people living there is tied very much to their relationship to the extraordinary land on which they live. This research and report are ultimately for those who love this land or call it home.

Slightly larger than the country of Switzerland, the Skeena Watershed is 54,342 kilometres square, and is home to five species of Pacific salmon and the largest strain of wild steelhead in the world. The watershed's rivers and lakes are pristine, allowing one to drink straight from the source. In addition to its people, this land provides a healthy home to the grizzly bear, mountain goat, moose, wolf, wolverine, steelhead, all five species of Pacific salmon and many other iconic species. Skeena Watershed is a precious, mostly intact ecosystem supporting the culture, economy and wellbeing of Upper Skeena communities.

Acknowledging the importance of this beautiful and fragile ecosystem, Skeena Watershed Conservation Coalition (SWCC) is a non-profit organization whose "mission is to cultivate a sustainable future from a sustainable environment rooted in our culture and thriving wild salmon ecosystem." Of critical importance within the SWCC mandate is strict adhesion to the reality that only in respectful relationships can such initiatives be successful. With a grant from Natural Resources Canada (Clean Energy for Rural and Remote Communities), SWCC commits to the important work of proposing solutions detailed by extensive community engagement and feedback, with firm intention of collaborating and creating opportunities that will honour and encourage solutions for energy security and sustainability.

Of primary importance in this endeavor is the necessity of identifying certain elements that endanger the health and welfare of the region's energy sustainability. In initial project consultation with community stakeholders, SWCC identified several key areas of specific concern regarding energy security in the region: power outages, energy costs, energy conservation, and emissions from diesel and fossil fuel power generation. The health and wellbeing of the salmon, culture and communities of the Skeena Watershed will remain the central focus throughout the process.

With these priorities and areas of concern in mind, a vision statement was developed for the Upper Skeena "Rural" Energy Plan (REP).

VISION STATEMENT:

This project will support communities and community members of the Upper Skeena in being a leader in renewable energy use, while reducing emissions from fossil fuels burned for heat and power by the adoption of renewable or highly efficient energy technology.

This vision statement was used to guide the development of the REP project. Building upon the vision statement, a number of principles have and will be used to guide the Regional Energy Plan (REP) development and future related projects:

- That the process to develop the REP allows for meaningful community engagement and input
- That the REP encourages economically viable and environmentally sustainable solutions.
- The REP will summarize the Upper Skeena Rural region energy use today and offer strategic and sound solutions on how to move forward towards a sustainable and secure energy future.

It is anticipated that the REP will bring social, environmental benefits, and long-term financial benefits to the region's residents and businesses once the plan moves to implementation. The underpinning motivation for this project is for the Upper Skeena rural region to have a secure and sustainable energy future.

INTENDED USES OF THE UPPER SKEENA "RURAL" ENERGY PLAN

- To assist in building energy literacy in community
- To articulate regional energy goals and issues to all levels of government
- To articulate regional current energy issues to BC Hydro
- To assist community in funding applications related to renewable energy
- To name the obstacles or issues that prevent energy security & sovereignty

This Regional Energy Plan is a living document that will be built upon as new information and changes occur.


1

1. PROFILE OF THE REGION

1.1 GEOGRAPHY

The region drawn for this study is bound by areas of the Upper Skeena that are rural by definition and are either on diesel power generation for energy needs or are serviced by the BC Hydro power grid.

The Empowered Energy Solutions project (EES) region of study is defined by the eastern boundary of the traditional territory, Madii Lii of Wilp Luutkudziiwus in the Suskwa Valley and the Northern boundary is the Bear Claw lodge in the Kispiox Valley. (See map on the following page.) The physical landscape of this region and territories is shaped by mountains and rivers throughout.

The Kispiox Valley, which makes up the largest area of the study region, is home to ancient village sites and trails that date back to a time before European contact when the Gitxsan people traveled and traded throughout this region. Century-old ranches and homesteads are a living testament to a way of life that helped shape the culture and community of British Columbia[1].

The land in the entire region is still traditionally used as people hunt, trap, and forage/gather sustenance and medicines. It is unceded Gitxsan land.

Figure 1-1 below provides a map of the study region and identifies the location of each project participant.

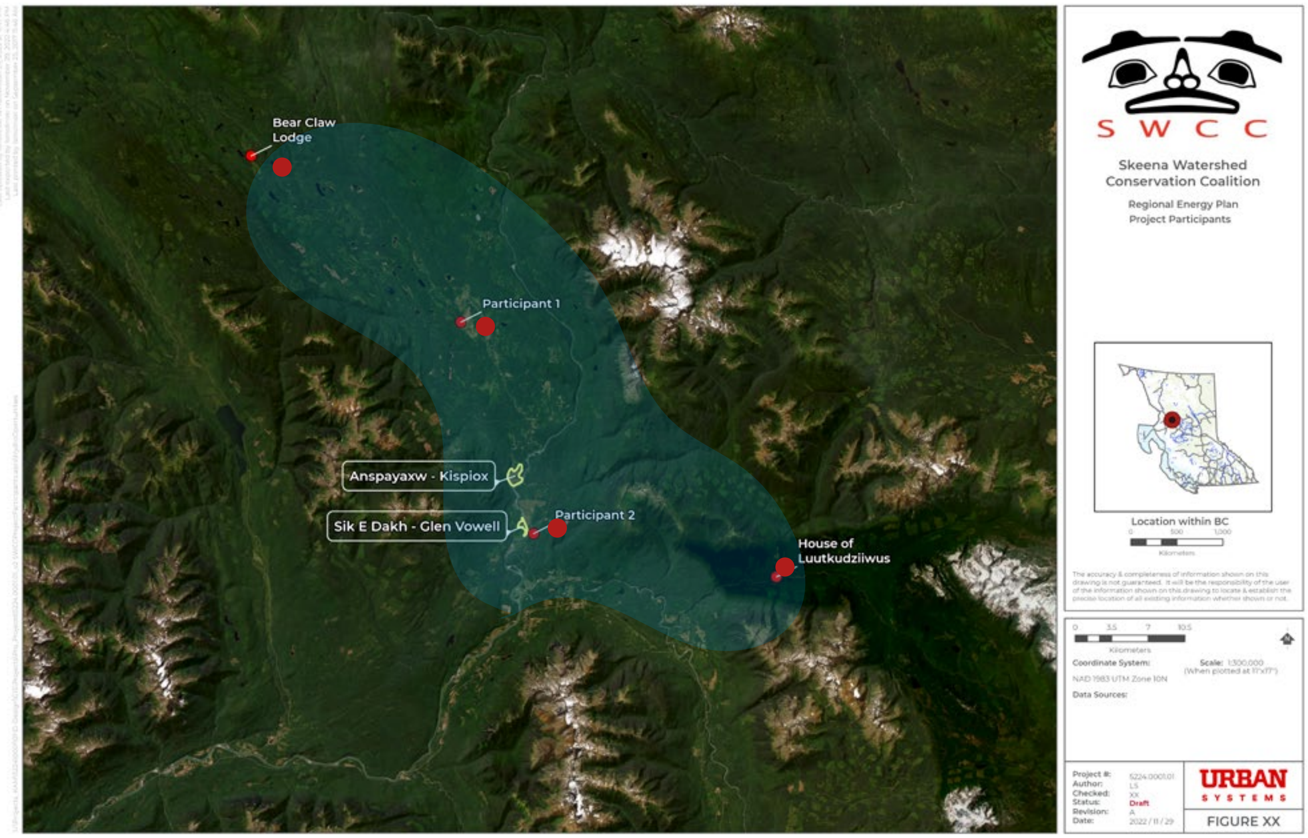

Figure 1-1: Map of Project Participants

The climate of the study area – Upper Skeena – is between the cool, wet conditions of the outer coast and the drier conditions of the interior of the province. This is the transition zone between the Great Bear Rainforest and interior forest. The local mountains provide protection from Pacific storms but also trap cold Arctic air in the winter. Spring brings periods of intense cold and snowy conditions in some areas thus the climate of this basin is transitional between the wet mild coast, and cold, dry interior. The cold, Arctic air that invades this basin allows a more interior forest type, the Interior Cedar – Hemlock forests to grow on the valley floor. Subalpine forests of Engelmann Spruce – Subalpine Fir occurs on the few higher hills and ridges[2]. This region has seven out of the nine geoclimatic zones of the Pacific Northwest which means that it has more biodiversity than anywhere in North America.

1.2 REGIONAL ENERGY USE

Until the early 1970's the Kispiox Valley was not connected to the BC Hydro power grid. Kispiox Valley residents and industry got their power and heat by either diesel generators for some applications like running Sawmills and homes were heated by wood stoves and illuminated by kerosene lanterns.

Before the 1980's there were more than 30 local sawmills running in the Kispiox Valley that milled local timber. Large amounts of diesel were brought in to power these mills and transport the products to market.

When power was extended into the Kispiox Valley it ended at KM 41 on the Kispiox Valley Rd and anything beyond is still not connected to the BC Hydro grid today.

The Madii Lii territory of Wilp Luutkudziiwus includes a settlement and culture camp powered by gasoline generator.

The residents that are on the BC Hydro power grid today have become dependent and reliant to the power grid and many homes do not have backup power for when the power goes out. Until recently, other power generation options were not available, reliable, or affordable to residents or businesses.

1.3 ECONOMIC DEVELOPMENT

Forestry has historically played a large role in the Upper Skeena regional economy. At many times in recent history, forestry and related industry has been the largest contributor to the local economy. Forestry employment includes timber cruising, harvesting, wood processing, silviculture, milling, and trucking.

The Kispiox Timber Supply Area covers an area of 1.22 million hectares in the northwest part of the province of British Columbia.

The largest employment sector in the Upper Skeena today is the public sector which includes education, health, safety, and government administration.

Tourism has a presence in the Upper Skeena but does not make up a significant number of jobs. The jobs in the tourism industry include fishing/hunting guiding, river rafting guiding, accommodation services and restaurants.

Mining within the Upper Skeena accounts for little economic development although there are many jobs held by local residents in mining and mineral exploration in other areas of Northern BC.

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2. REGIONAL ENERGY ASSESSMENT

2.1 PROJECT PARTICIPANT SELECTION

This project focuses on rural and remote communities and their energy needs and energy literacy. To understand the region's current situation with energy use and needs, we selected a cross section of energy users. The selection criteria included:

- Areas that are connected to the power (rural) grid but not to natural gas
- Areas where energy security is compromised by grid reliability and cost
- Areas "off grid" that are powered and heated by diesel or other fossil fuels
- Rural residents that are interested in renewable energy and adopting technology that made sense for their situations
- Residents that use power for different reasons (industrial, and farming); and
- Scale – examining Indigenous rural communities and the energy issues faced by their government and residents

Multiple stakeholders participating in the planning effort will strengthen the regional planning process.

2.2 EMPOWERED ENERGY SOLUTIONS PARTICIPANTS

The following section provides a brief background on each of the project participants, including why they were selected for the project and an overview of the energy issues they are currently facing.

Anspayaxw - Kispiox Reserve

Anspayaxw is known locally as Kispiox Village and is situated within the Gitksan Territory fifteen kilometres on the Kispiox Valley Road north of Hazelton at the junction of the Kispiox and Skeena Rivers. The size of the community is 1650 acres.

Anspayaxw, the traditional name of this community, translates to "Hiding Place". The community of Anspayaxw is one of six ancient Gitksan communities which exist today in the area. It is estimated to be about 3,000 years old, having existed, like several other villages, since the time the population was dispersed from the ancient city of Txemlax'amid by a disaster. Archaeological and oral history evidence indicates that the Gitksan occupied the valley of the K'san or Skeena River following the last ice age about 10,000 years ago. There are many Gitxsan ancient villages that no longer exist due to natural disaster and genocidal policies enacted to remove indigenous people from their homelands.

Kispiox Band has a total membership of 1,670 members as of December 31, 2021 – 578 reside on-reserve and 1,092 members reside off-reserve. The total population, which includes their members, other band members, non-registered and non-native residents, is approximately 737 as of December 2021.

Kispiox Band, the reserve government, is governed by an elected body consisting of nine Councillors and one Chief Councillor. The Kispiox Band Office staff consists of fifteen permanent full-time employees, two machine operators, casual labourers and seasonal silviculture crews[3].

In the last ten years, this community has continually seen growth in population and services provided to their membership. They are connected to the BC Hydro Power Grid.

Anspayaxw - Kispiox Reserve

Current Energy Issues

Many Band homes were poorly built upon initial build and were not suitable for the regional climate. Currently these homes need energy retrofits including new windows, doors, improved insulation value, new roofs, proper weatherstripping and proper venting.

When the power grid came to the valley, energy was cheap, and the area became reliant on electric heat and power. There have been many benefits to the power from BC Hydro although it did bring new issues for the community's well-being. There are frequent power outages known as "brownouts" and now some of the community's most vulnerable, like Elders, are left with their electricity dependant utilities not working. This includes issues such as furnaces and lights not working in winter temperatures and darkness, and not having alternatives for cooking if electric stoves are not working. Most people in the area have electric wall plug-in phones as opposed to jack plug-in only. When the power goes out their phone lines are disconnected, as well as wifi, leaving them unable to reach emergency services or any sort of assistance if needed.

The energy supply-chain issue is a result of this region's power line right-of-way being located through a very densely treed corridor. As an area with frequent heavy windstorms and snowfall, the trees often fall onto the lines causing up to a week of no power (depending on the severity of the storm). 2021 to present has seen a higher frequency of brownouts than past years.

The Kispiox Band is committed to achieving economic self-sufficiency which includes energy self-sufficiency. This will be achieved through training, education, and creating opportunities for community members.

A funding application has recently been completed and submitted to Indigenous Canada Services to explore alternative energy for the community. The funding request is for a Feasibility Study on Solar panels and Run of the River projects. The study could lead the community to independence and not be completely reliant on BC Hydro energy needs.

The Empowered Energy Solutions project is supporting the community's renewable energy goals and creating the necessary capacity to assist in reaching those goals.

Table 2-1 below summarizes Kispiox's community infrastructure and the organization responsible for the utility costs.

Table 2-1: Kispiox Community Infrastructure

Infrastructure in Community	Responsibility for Utility Cost
249 Houses	Resident
Band Office	Band
Fire Hall	Band
KBC Water Treatment Plant	Band
Cultural/Information Center	Band
Pentecostal Church	Pentecostal Church
Teacherage	Anspayaxw School Society
Community Center	Band
ABE Building	Band
Vacant Cafe	Unknown
Anspayaxw Health Center	Band
Headstart	Anspayaxw School Society
Elementary School	Anspayaxw School Society
Daycare	Gitxsan Child and Family Services
United Church Manse	United Church Manse
G.W.A. Hatchery Trailer	G.W.A
Old Fire Hall	Band
Gasbar	Band
Hiding Place Gallery	Hiding Place Gallery
Thelma Blackwater Variety Store	Thelma Blackwater Variety Store

BC Hydro electricity bills are often very high and difficult for some residents to pay. SWCC and our team have heard from residents and leadership that they often must choose between keeping the power on or buying groceries.

Wilp Luutkudziiwus

Submitted by Pansy Wright-Simms, Spokesperson

Luutkudziiwus is a House Group (Wilp) of the Gitxsan Nation who continue to use and occupy their traditional territories (Lax Yip) as they have since time immemorial.
Guided by Gwalx Yee'insxw, the most sacred of Gitxsan obligations and responsibilities. "Gwalx Yee'insxw" is grounded in principles that encompass our ancestral inheritance handed down through generations. This inheritance – the land, rivers, mountains; all life on the land, in the air, and in the waters; our history and culture; our spiritual areas and sites; the tangible and the intangible – is passed from one generation to the next, never extinguishing or diminishing in value.
Luutkudziiwus' special relationship to and stewardship of land, water, and respective resources on our territories provide grounds for and affirms our inherent Indigenous rights guaranteed by Section 35 of the Constitution. As such, Luutkudziiwus has responsibilities to ensure our lands, waters, and resources will always support the needs of our House members.

Luutkudziiwus territories are located adjacent to the Skeena River, which hosts the second largest sockeye salmon run in Canada and supports the other Pacific salmon, including chinook, coho, pink, chum, and steelhead. Salmon form the backbone of our traditional foods and are currently used by Luutkudziiwus Wilp members as our main food source, as well as for social, economic, and ceremonial use.
Luutkudziiwus plans include community-based cultural revitalization programs for First Nation family and friends, as well as providing opportunities for non FNs to take part in our culture and traditions in order that we may all build a better world. We value your continued support in our efforts to decolonize, sustain social justice, protect our environment, and slow down climate change by helping to stop fracking and pipelines.

Wilp Luutkududziiwus
Current Energy Issues

Wilp Luutkudziiwus relies on gasoline generators to provide electricity to the community in addition to the reliance on fossil fuels for space heating. As a result, many residents of the Wilp are faced with significant energy costs, resulting in several social, environmental and economic implications.

Wilp Luutkudziiwus is actively looking at renewable energy technologies for Madii Lii with the goal of eliminating fossil fuel use for power and heating needs.

Sik E Dakh

Sik-E-Dakh (Glen Vowell Indian Band) is one of 7 First Nations reserves that the Federal Government of Canada established on the traditional territories (Lax'yip) of the Gitxsan Nation. Sik-E-Dakh is a community of 429 members (231 living on reserve) and is situated on prime farmland bordering the Skeena River. Sik-E-Dakh is the name of the mountain that stands by the community and translates to "Bright Lights Behind". The entrance to the Sik-E-Dakh community is located at 10.5 km on the Kispiox Valley Rd.

The community vision of Sik-E-Dakh is as follows: "A healthy, safe, positive community that is sustainable now and for future generations. We will achieve our vision by helping people to help themselves through education, economic development, positive reinforcement and traditional teachings."

Sik-E-Dakh incorporated a business called Sik-E-Dakh Development Ltd. (SDC) February 25, 2015. The mission of the SDC is to provide economic development that supports the development of agriculture initiatives, while prioritizing Healthy Families, Safety and Security, Heritage, Self-Sufficiency and Food Security. In April 2019 the SDC passed a resolution to make agriculture a priority industry for the Sik-E-Dakh Community.

The Gitxsan Health Society also works in partnership with the Sik-E-Dakh Band Office and supports all areas mentioned above, as well as providing supports for all areas of wellness, with a focus on using traditional medicines where possible.

Between these three, local organizations, there is a commitment to continue to create a healthy, safe, positive community that is self-sufficient now and for the future generations.

In Sik-E-Dakh, self-sufficiency includes energy sovereignty. The Band has been active securing renewable energy in the community to augment and lessen dependency on the BC Hydro grid. Sik-E-Dakh currently has a greenhouse powered by solar, the Band Office has 100 solar panels just installed on the roof and a new housing development with solar back up.

Sik E Dakh

Current Energy Issues

The major energy issues in Sik-E-Dakh are the high volume of black and brownouts (energy reliability issues) and the high cost of Power from BC Hydro for both residents and Band infrastructure. Sik E Dakh purchased a gasoline generator for each home to mitigate some of the issues brought on by the power outages.

It is very common in Sik-E-Dakh to have residents have their power cut off from not being able to afford Hydro bills. Recently Sik-E-Dakh successfully negotiated with BC Hydro to get the high cost of reinstating power service to residents removed.

Table 2-2 below summarizes Sik-E-Dakh's community infrastructure and the organization responsible for the utility costs.

Table 2-2: Sik E Dakh Community Infrastructure

Infrastructure in Community	Responsibility for Utility Cost
84 Houses	Residents
New Band Office	Band
Old Band Office	Gitxsan Child and Family Services
Longhouse	Gitxsan Child and Family Services
Water Treatment facility	Band
Gitxsan Health Society	Gitxsan Health Society
Community Greenhouse	Band owned (Solar)
Firehall	Band
Church	Salvation Army

Participant 1 - Kispiox Valley Ranch
(herein referred to as 'The Ranch')

In the Kispiox Valley there are farms and ranches throughout. These farms and ranches range from 5 acre to 1000 acres with most falling within 15-100 acres and often have cattle, horses, pigs, chickens, produce and hay for livestock sustenance and for sale. These farmers and ranchers have different energy needs than other participants in the study.

This Ranch has a large cattle operation, a shop, and two homes on the property. The electrical needs for these two residential dwellings are for lighting, plugs, and appliances. The Ranch electricity needs are for lighting, heated waterers for the winter in the two barns, heated and powered shop and the electricity for the water well for all home and ranch needs.

Current Energy Issues

The energy issues at The Ranch are entirely about energy reliability. The amount of power outages makes it necessary to be thinking about a power backup especially in the winter season.

This rancher has strong interest in self sustainability and has the goal of getting off the power grid in the future.

An energy audit was conducted on the main home of this ranch and for the purposes of this research, it provides us with a traditionally built, stick frame example for the energy conservation section of this report. Understanding and dealing with energy loss is as important as getting efficient heating solutions.

Participant 2 - Salmon River Farm & Mechanical Shop

Terry Bexson and Debbie McGhee own and run the Salmon River Mechanical & Ranch. They have a well-developed interest in being self-sufficient with their food as well as their energy needs.

Their electrical needs are for a Log Home, mechanical shop, barns and outbuildings.

As part of this project, they received an energy audit for their log home. The energy audit/ assessment results were used as an example in the Energy Conservation section of this report to provide energy loss information and solutions to other log homeowners in the area.

The owners of this property have decided to get solar infrastructure this coming year and are currently deciding on a suitable heating option.

Participant 3 - Bear Claw Lodge

Bear Claw is a world-renowned wilderness lodge - a 15,000-square-foot luxurious timber frame in the remote, upper Kispiox Valley on Gitxsan territory. Nestled alongside the Kispiox River, the lodge was designed to feel like a home away from home. The beautiful architecture and design reflect the land, culture and people of the Kispiox. The lodge itself was designed and built by local craftsmen and artists both Indigenous and settler. The lodge is partially owned and wholly operated by a local family.

The lodge is powered by two 60-kW diesel generators in the winter months and getting Solar infrastructure installed in spring 2023 which will allow the business to reduce to 35 kW generators for winter backup to a 30kW solar system. The main lodge is heated by a propane boiler system.

Propane is also used in the kitchen as the cooking fuel. There is a propane heated hot tub as well as an electric air conditioner and sauna. Fuel costs for both propane and diesel are upwards of $200,000 per year and Bear Claw has made several, previous attempts to convert the lodge to solar as well as other alternative energy and heat systems. Considerable investment has been made to not only lessen the carbon footprint of this commercial operation, but to also attempt to demonstrate that making that transition is a financially sound decision. This process has been incredibly frustrating due to several issues including installation of faulty equipment, some alternative systems that do not function well with 3-phase power, and a historical lack of infrastructure and knowledge in the region on how to retrofit commercial operations such as the Bear Claw property.

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3. ENERGY CONSERVATION

Shelter can take many forms, shapes and sizes. It is a primary means for us to be comfortable by controlling our environment, which is achieved through energy management. A foundation, roof and walls, and the building envelope provide protection from the elements and allow for the concentration or dissipation and redirection of heat and moisture. Mechanical systems within a shelter, such as a furnace or hot water heater, convert one form of energy, like electricity, into a usable form of energy, like warm air or hot water. Increasing the energy efficiency of our homes increases our comfort, reduces our costs and in return, diminishes the negative effects we create within our environment by producing less pollution, locally and regionally.

Any shelter or home must be viewed as an integrated system. Any change to one aspect of the home will positively or negatively affect all other parts of the home. For example, increasing insulation levels in the walls and ceiling can decrease the loss of heat. While this is often only viewed positively because energy consumption of the building is reduced, the current furnace might become inefficient if it has become oversized as a result of the change. This is not to say that improvements should not be undertaken, but only that all aspects of any changes should be carefully considered.

As a rule, the path to greater energy conservation can be achieved by reducing energy loss, optimizing effectiveness and efficiency of materials and utilizing renewable sources of energy. The order in which these steps are taken is important. Examples of energy loss include excessive air leakage or uninsulated spaces, such as uninsulated concrete basement walls. Although the usage will vary greatly depending on many factors, an older home in a northern climate may use 140 GJ of energy in a year. Air leakage could account for 28 GJ (20%) of energy wasted (or more) and most of the air leakage could be due to easy-to-fix areas such as drafty doors and windows or leaky dryer vent installations or chimneys – there could be many such areas. A new high efficiency furnace could save that much energy or photovoltaic solar panels could generate that amount, but it is far less expensive to correct the air leakage first and then any further improvements will be that much more effective. Uninsulated basements can also account for up to 20% of energy loss and again, can usually be insulated for far less cost than new mechanical or heat generation systems.

Often overlooked, proper and adequate ventilation is vital to a healthy home. Without proper ventilation, moisture can promote mold growth and other undesirable health related effects and can lead to materials degradation (such as in drywall integrity or insulation effectiveness). In an older home, air leakage can provide the necessary ventilation to ensure that moisture buildup is not an issue, but often, because the air leakage is uncontrolled, energy loss is excessive. In the case that an older home is made airtight, a mechanical solution such as a Heat Recovery Ventilator (HRV) can be installed to address any potential ventilation issues. Older homes can be quite leaky through many small holes or gaps, and it is unlikely that these will all be corrected. If moisture becomes noticeable such as with condensation buildup on windows, it is best to consult with a professional building envelope specialist.

More comprehensive and detailed descriptions of these subjects can be found in the publication “Keeping the Heat In” by Natural Resources Canada[4].

In support of the goals and vision of the Empowered Energy Solutions Project, energy analyses of two residential homes and one commercial operation were performed. The first home is a log structure and represents alternative but traditional building methods. The second home is an example of the familiar stick-built frame consisting of 2x6 walls on a preserved wood foundation with a drywall interior and wood siding exterior. The commercial operation is a multi-seasonal timber frame lodge hosting guests for recreational activities including fishing and heli-skiing. The methodology for each home analysis involves an in-person site inspection where photographs of relevant areas are taken, such as foundations, walls, roofs, windows and doors. The dimensions of each distinct structural component including the materials used are recorded and the data collected is entered into modeling software to provide a breakdown of energy usage. Case studies were developed from these analyses.

3.1 CASE STUDY 1 - **Stick Frame Home**

The first case study is a familiar style stick frame home. Stick frames homes are currently the most common, primarily because of ease of construction and that they lend themselves to meeting code requirements – which ensure safety and comfort – without much modification. This home was built in 1985 on a preserved wood foundation and is one story. The framing is 2x6 and has a gable style roof type. The main heating system is an electric furnace complimented by a catalytic wood burning stove located in the basement. The hot water is provided by an electric heated tank.

The heated floor area, including the basement, is 2,151 sq ft. The home is rated to use 123 GJ of energy per year whereas a typical new home of the same size would consume 93 GJ of energy. Figure 3-1 below provides an image of the exterior of the home.

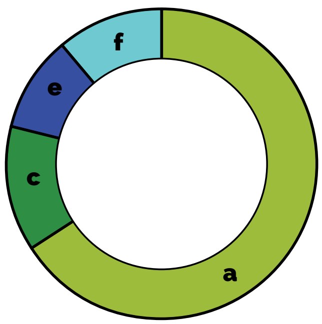
Figure 3-1: Case Study 1 – Photograph of the Stick Frame Home

HOW THE ENERGY IS USED

The following graphic (Figure 3-2) shows that most of the energy from this home is used in space heating.

HOW YOUR RATED ENERGY IS USED

The chart below represents the breakdown of rated annual energy consumption in your home under standard operating conditions. You can use these figures as a guide to help identify where you can lower home energy costs through proper home maintenance, efficient home operatioin, energy efficiency renovations or equipment reeplacement.



a.	Space Heating	66%
b.	Space Cooling	0%
c.	Water Heating	13%
d.	Ventilation	0%
e.	Light & Appliances	10%
f.	Other Electrical	11%

Figure 3-2: Case Study 1 – Energy Use Breakdown in the Stick Frame Home

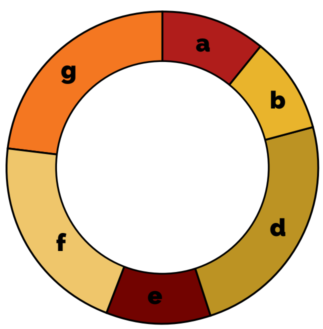
However, a reasonable and not uncommon percentage is attributed to the other energy consumers. A heat pump with a HSPF of 10 (approx. 293% efficient) saves 29 GJ or 23.5%. By upgrading the heating to a heat pump, space heating would account for 55% of the usage, water heating, 17%, lighting, 12% and other, 15%. In a northern climate such as that found in the Skeena region, a heat pump would not provide the required heat for the entire heating season. Therefore, keeping the wood heat source and potentially the electric furnace would be recommended.

WHERE THE HOME LOSES HEAT

The following graphic (Figure 3-3) shows a breakdown of where heat is lost in the home.

WHERE YOUR HOME LOSES HEAT

Houses lose heat through their exterior shell, or building envelope. The chart below shows where and how your home loses heat. The quality and upkeep of your home can have a major impact on the amount of energy your heating an cooling systems use annually.



a.	Attic/Ceiling	11%
b.	Main Walls	10%
c.	Exposed Floors	0%
d.	Windows	24%
e.	Exterior Doors	11%
f.	Basement/Foundation	21%
g.	Air Leakage/Ventilation	23%

Figure 3-3: Case Study 1 – Energy Loss Locations in the Stick Frame Home

In this case, the largest contributing factors to energy loss are the windows, air leakage and the basement foundation. The air leakage in this home was quite high at 6.89 air changes per hour (ACH) where a more airtight stick-built home might have a 3.5 ACH.

If the air changes in this home could be improved to 4.0 ACH the energy usage would drop to 111 GJ, a 12 GJ or 9.7% energy savings, the space heating would account for 62% and the loss due to air leakage would drop from 23% to 15%.

POTENTIAL UPGRADES

The analysis suggests that the first steps toward improving energy conservation should be focused on the largest gaps: replace the older dual glazed windows with high efficiency triple glazed units, improve the air tightness of the home, better insulate the basement foundation and increase the efficiency of the heating system. However, adding insulation to the exterior of the basement would be beneficial but cost prohibitive. The basement interior is insulated and more could be added, but this would also be quite disruptive since the walls are finished. The next best option, since the exterior siding may need to be replaced would be to add rigid exterior insulation to the above grade walls – the air barrier could be significantly improved at this time. As well, the attic insulation could be increased.

If the air leakage, the windows, the attic insulation and the exterior wall are upgraded, the home would be rated at 83 GJ, a 32.5% improvement and better than a typical new home. By upgrading to a heat pump as well, the home would be rated at 70 GJ, a 43% improvement. In this final case, the space heating usage would be 38% and water heating, 23%. The walls would then account for 9% heat loss, the attic would account for 7% and the windows, 15%, with the air leakage at 20%.

Table 3-4 below summarizes the estimated results of these changes.

Table 3-41: Summary of Energy Usage Improvements

Retrofit	Home's Energy Usage Rating	Improvement over Typical New Home
Air leakage, windows, attic insulation, exterior wall upgrades	83 GJ	32.5%
Heat pump	70 GJ (13 GJ additional reductions after completing retrofits above)	43% (10.5% additional improvements after completing retrofits above)

3.2 CASE STUDY 2 - **Log Home**

The second case study is of a log home, owned by Debbie McGhee and Terry Bexson. It was built in 1978 on an uninsulated concrete foundation and is two stories. The logs are an average 12" in diameter and has a barn-style or gambrel roof type. A portion of the second floor overhangs the front entrance and is considered exposed. The main heating system is a wood stove located in the basement and the hot water is provided by an electric heated tank. The heated floor area including the basement is 2,312 sq ft. The home is rated to use 268 GJ of energy per year whereas a typical new home of the same size would consume 132 GJ of energy. Figure 3-4 below provides an image of the exterior of the home.

Figure 3-4: Case Study 2 – Photograph of the Log Home

HOW THE ENERGY IS USED

The following graphic clearly shows that most of the energy from this home is used in space heating which overshadows all other energy usage. This is not uncommon and especially in a home that utilizes wood as a heating source. Although wood heat appliances can vary greatly in their efficiency (anywhere from 50% for an open fireplace to 80% and higher for an outdoor wood boiler), an older stove may be around 70%. Depending on how the wood is sourced, the cost could be far less than other sources of heat, however, this does not change the amount of energy that is being consumed – a 50% efficient appliance will use twice as much energy to achieve the same amount of heat as a 100% efficient appliance. If a natural gas furnace at 96% efficiency were installed, this home's rating would change to 185 GJ per year representing an 83 GJ or 30.9% energy savings. Similarly, a 100% electric furnace saves 31.7%, but a heat pump with a HSPF of 10 (approx. 293% efficient) saves 62.3%.

Figure 3-5 below provides a summary of how the energy is used in this home.

HOW YOUR RATED ENERGY IS USED

The chart below represents the breakdown of rated annual energy consumption in your home under standard operating conditions. You can use these figures as a guide to help identify where you can lower home energy costs through proper home maintenance, efficient home operatioin, energy efficiency renovations or equipment reeplacement.

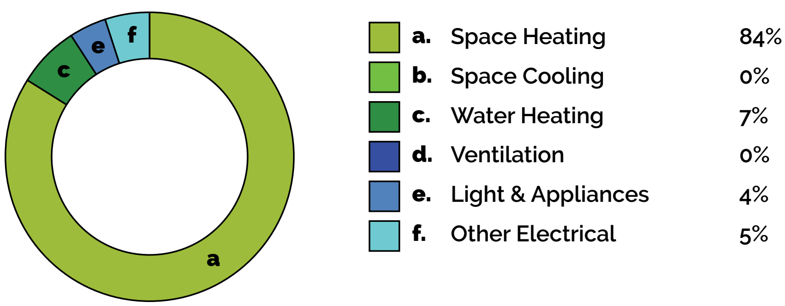


Figure 3-5: Case Study 2 – Energy Use Breakdown in the Log Home

As noted in the introduction, the home is to be viewed as a system, so if other areas of the home such as insulation or air leakage were improved, these savings would likely be less, but the impact would still be significant. For example, with a heat pump installed, space heating would account for 55% of the usage, water heating, 18%, lighting, 12% and other, 18%. In a northern climate such as that found in the Skeena region, a heat pump would not provide the required heat for the entire heating season. Therefore, keeping the wood heat source would be recommended.

WHERE THE HOME LOSES HEAT

The following graphic (Figure 3-6) shows a breakdown of where heat is lost in the home.

WHERE YOUR HOME LOSES HEAT

Houses lose heat through their exterior shell, or building envelope. The chart below shows where and how your home loses heat. The quality and upkeep of your home can have a major impact on the amount of energy your heating an cooling systems use annually.

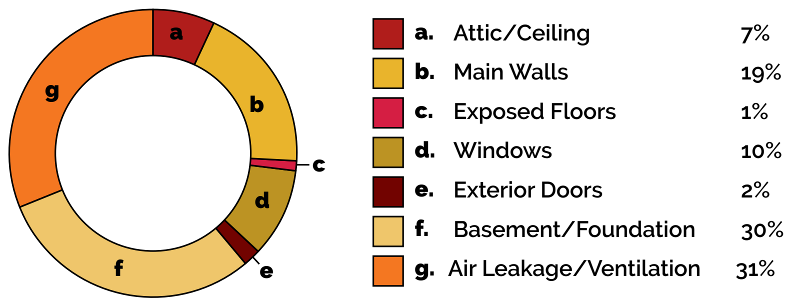


Figure 3-6: Case Study 2 – Energy Loss Locations in the Log Home

In this case, the largest contributing factors to energy loss are air leakage and the basement foundation. For various reasons, the air leakage in this home was quite high at 12.42 air changes per hour (ACH) where a more airtight stick-built home of a similar age might have a 3.5 ACH. Log home construction has very few opportunities to prevent air leakage. Ordinarily, a home would be built with a continuous air barrier containing the building envelope – there are several different methods, but you might commonly see a product such as Tyvek TM applied to the exterior sheathing in a home being built as part of the air barrier system.

A log home is built primarily of wood and over time, the wood shrinks or warps and there are naturally gaps where the logs join or rest on each other. Chinking between the logs can be applied on interior and exterior, but it is very difficult to ensure all spaces are closed. This home also had old chimney installations which were not well sealed.
If the air changes in this home could be improved to 5.0 ACH the energy usage would drop to 210 GJ, a 58 GJ or 21.6% energy savings, the space heating would account for 78% and the loss due to air leakage would drop from 31% to 13%. Independent of modifying the air leakage, adding a 2x4 wall with R12 value insulation to the interior of the concrete basement walls would drop the rating to 231 GJ, a 37 GJ or 13.8% savings.

POTENTIAL UPGRADES

The analysis shows that the first steps toward improving energy conservation should be focused on the largest gaps: improve the air tightness of the home, insulate the basement foundation, and increase the efficiency of the heating system. If only these three items are addressed, the home would be rated at 80 GJ, a 70% improvement and better than a typical new home. In this case, the space heating usage would be 44% and water heating, 23%. The walls would then account for 28% heat loss, the attic would account for 11% and the foundation, 25%, an increase in each, with the air leakage at 16%. The house components are all integrated and a change in one or more changes all the others.

Other potential upgrades include increasing the attic insulation to R50 from R12 and R19, increasing the wall insulation for the upper walls that are not made of log from R12 to R20 with the addition of rigid exterior insulation and replacing the older windows and door to more efficient units. The door and window upgrades offer the added benefit of helping to reduce the air leakage through professional installation.

3.3 CASE STUDY 3 - **Bear Claw Lodge**

Bear Claw Lodge is a beautiful timber frame facility located in a pristine setting on the banks of the Kispiox River. It provides seasonal recreation activities including fishing in the summer and fall and heli-skiing in the winter. However, it is in a remote location and as such, totally off-grid – there is no access to either piped natural gas or connected electricity. All data was collected through on-site observation, examination of details in photos of the construction and conversation with the staff.

Figure 3-7 below provides an image of the exterior of Bear Claw Lodge.

Figure 3-7: Case Study 3 – Photograph of Bear Claw Lodge

EXISTING CONDITIONS

The building envelope consists of an insulated concrete slab foundation. The framed walls vary from a 2x4 construction for the great room to greater depths on the half-buried back side of the building. The roof construction is relatively low profile, and the resulting insulation level is expected to be comparatively low. The windows are double pane glazing and the rooms have sliding glass doors which exit to the outside.

Further increasing the energy demands are the commercial kitchen, a gear drying room, a hot tub and de-icing cables on the roof. The great room, which extends over two floors, has a large fireplace which may be a source for heat to escape when it is not in use. Comments from the staff indicate that there is a great deal of variability in the temperatures that may be encountered within the facility. A large solar array on the roof is functional but not currently connected to a battery bank.

Electricity in British Columbia is primarily (~90%+/-) generated through hydroelectric facilities which are generally considered as a renewable source of energy. Therefore, using this relatively clean electricity source for our energy needs rather than fossil fuels make sense. However, because Bear Claw is off-grid, it uses a diesel-powered generator to produce the electricity it consumes and burns propane for both the hot water and in a boiler system which provides in-floor heating to the facility. A connection to the grid is not feasible due to Bear Claw's distance from existing grid infrastructure, so solutions to increasing the energy efficiency for the facility are complex and would require a detailed analysis for an optimized solution which was not a part of the scope of this study.

POTENTIAL SOLUTIONS

BUILDING ENVELOPE UPGRADES

As with most structures, improving the energy efficiency of the foundation can be challenging and expensive. The slab is insulated from below, but there was no evidence found of the slab being insulated around the perimeter. The slab has radiant in-floor heating, and a great deal of heat may be lost through the exposed edge. Excavating to a minor depth and installing an insulation product around the perimeter – where it is accessible - would be beneficial.

The issue of a partial or non-existent air barrier in combination with the timber frame could be a source for a great deal of heat loss. Technology is available whereby a particulate is aerosolized in a pressurized structure which seals any small gaps or holes creating a significantly more airtight envelope. Because Bear Claw is primarily wood rather than drywall, this technology may not be appropriate, but it would be worth inquiring with a company to see if possibilities exist. Currently, Aerobarrier in Prince George provides this service.

The roofing materials may need to be replaced within the next few years. At this time, the roof insulation level could be increased significantly with the addition of a layer of rigid foam or structurally insulated panels. This upgrade may also reduce the need for the energy-consuming de-icing cables because ice dams could be prevented by preventing heat loss through the roof.

The fireplaces located in the great room and in Figure 3-8 below are a potential source of a large amount of heat loss when they are not in use due to the stack effect where a natural draft may be funneling the interior air to the outside. The chimney system should be assessed by a heating professional to ensure that the appropriate systems are in place to reduce this heat loss

Figure 3-8: Case Study 3 – Fireplaces in the Great Room

MECHANICAL SYSTEMS — CONSIDERATIONS & UPGRADES

As with any commercial operation, there is a complex mix of mechanical appliances in place to produce and distribute heat and to ventilate the structure including the hot water heaters, heat recovery ventilators and boilers.

Grid connected energy is not possible, otherwise an immediate move to heat pump technology would be recommended to reduce the use of fossil fuels. Heat pumps do not produce heat but move heat from the outside environment to the interior using refrigerants like how a refrigerator operates.

Heat pumps, whether air source or geothermal, can be up to 300% to 400% more efficient than electric heat, but they do still consume a reasonable amount of electricity. Increasing electricity usage with heat pump technology would also increase the demands on the diesel run generators, thereby increasing the cost and detrimental effects on the environment including the carbon footprint.

The propane used to heat the lodge is a cleaner fossil fuel than the diesel used for the generators, so making the move to a heat pump would not be beneficial at this point. Bear Claw is in the planning stages for reimplementing a photovoltaic (PV) solar panel strategy to reduce the need for the diesel generators. Figure 3-9 below depicts the existing solar PV system on the roof of Bear Claw Lodge.

Figure 3-9: Case Study 3 – Existing Solar PV System

Planning the system to be able to support the use of heat pump technology would be very beneficial in the long run and it is highly recommended to pursue this path. If it is not possible to install a PV system large enough to accommodate the replacement of the current fossil fuel usage entirely with heat pumps, smaller air source heat pumps could be employed, and the evaporators could be strategically located within the facility. The guest rooms or kitchen may be a good placement for example. As well, the mechanical room produces a great deal of waste heat. A heat pump water heater could be installed in the mechanical room to capture this heat to augment and pre-heat the water that goes into the hot water heaters. A similar configuration may be possible to provide heat to the gear drying room.

Wood fired boiler technology has improved greatly and relatively clean burning units (99.5% combustion efficiency) can reach up to an 86% burn efficiency – for example see the Polar G-Class model wood boilers. With an abundance of available wood nearby, this technology could also be explored as a replacement for the current propane boiler system.

The hot tub is a very attractive feature of the lodge, but it consumes a great deal of energy. If it were possible to construct an outdoor wood heated hot tub to be used, when possible, the energy savings could be significant.

3.4 ENERGY CONSERVATION SUMMARY *FOR 3 CASE STUDIES COMPLETED*

Energy analyses were performed on three diverse shelters and case studies were developed with results that reflect a diversity of building styles and energy conservation challenges. Each building must be viewed as an integrated system where changes to one aspect of energy usage affect all others. Although certain upgrades may provide more benefit, not all can be reasonably carried out and some may be cost prohibitive, so compromises must often be considered. Each house must be assessed individually to determine the feasibility of upgrades.

Due to degradation of materials and shifting structural components, one of the most common culprits for energy loss in older buildings is air leakage. There are several ways to correct air leakage, but often larger gaps which can be easily identified and blocked will provide a significant benefit. All other paths to energy conservation rely on a careful and balanced approach dependant on building materials and construction methods.

COMMUNITY OF ANSPAYAXW

Although energy audits were not completed throughout Anspayaxw due to the timeframe of this project, the community has previously completed and is actively working to complete a number of energy conservation initiatives.

More specifically, Anspayaxw has participated in the Home Energy Check-up Stream of the BC Hydro Indigenous Communities Conservation Program (ICCP). This program involves installing a number of free, energy saving products in community homes, including (but not limited to) LED lighting, faucet aerators, high-performance showerheads, door sweeps, window film, and smart power strips.

Anspayaxw is also actively working to retrofit homes with air source heat pumps (ASHPs). This process has involved beginning ASHP retrofits, with existing heating systems for “backup” on Elders’ homes as “example” properties. This pilot project is intended to demonstrate how energy bills on these homes may be reduced through the winter.

If this pilot project is successful, it is understood that Anspayaxw plans to continue retrofit efforts on other homes throughout the community. It should be noted that this ASHP retrofit initiative may be challenging to implement due to power supply limitations and reliability issues in the community, as discussed further in Section 5.0.

4

4. ENERGY USE & EMISSIONS BASELINE FOR THE REGION

To establish a strong understanding of the energy use and greenhouse gas (GHG) emissions in the region, an energy use and emissions baseline was developed as part of the regional energy plan. This baseline considered energy use in the rural Upper Skeena region from all sources, including BC Hydro and diesel-generated electricity, propane, wood, and fuel oil. The data, methodology and analysis used for the development of the project's energy use baseline are described throughout the following sections.

4.1 ENERGY USE BASELINE

To develop the energy use baseline, information on annual energy costs and usage was collected and estimated (as required) for all participants of the project[5]. The information in Table 4-1 below summarizes the estimated energy costs as provided by each smaller-scale project participant. The larger-scale project participants (communities of Anspayaxw and Sik-e-Dakh) had their energy usage estimated using a different methodology, which is described in greater detail further below in this section.

Table 4-1: Estimated Energy Costs per Year (Small-Scale Participants)

Project Participant	Diesel-Generated Electricity	BC Hydro Electricity	Propane	Wood	Total
Case Study 1 – Stick Frame Home		$3,600		$0 (wood still utilized as a fuel source)	$3,600
Case Study 2 – Log Home		$1,300		$0 (wood still utilized as a fuel source)	$1,300
Case Study 3 – Bear Claw Lodge	$150,000		$50,000	$0 (wood still utilized as a fuel source)	$200,000
Madii Lii	$500				$500

Using the assumptions summarized in Table 4-2 below, the energy usage per year was estimated for each of the project participants, which is shown in Table 4-3 following the table below.

Table 4-2: Estimated Energy Rates by Fuel Source

Fuel Source	Energy Cost	Unit
Diesel-Generated Electricity	$1.74	per L
BC Hydro Electricity	$0.09500	per kWh
Propane	$1.3000	per L
Wood	$225[6]	per cord

Table 4-3: Estimated Energy Usage by Fuel Source

Project Participant	Diesel-Generated Electricity (kWh)	BC Hydro Electricity (kWh)	Propane (L)	Wood (GJ)
Case Study 1 – Stick Frame Home		38,000		63
Case Study 2 – Log Home		13,700		165
Case Study 3 – Bear Claw Lodge	918,900		38,500	38
Madii Lii	7,500			

In order to estimate the energy use for the larger-scale participants (communities of Anspayaxw and Sik-e-Dakh), information on heating sources for each home was utilized to estimate the energy consumption and GHG emissions.

Table 4-4 below summarizes the estimated number of homes utilizing each type of heating source in the community. Please note that data for the heating sources was not available for Sik-e-Dakh, therefore it was assumed that the community had a similar breakdown of home heating sources to Anspayaxw.

Table 4-4: Estimated Number of Homes Utilizing Each Heating Type

Fuel Source	Anspayaxw	Sik-e-Dakh	% Breakdown
Electric	138	46	56%
Fuel Oil	2	1	1%
Wood	103	34	42%
Propane	5	2	2%
Total	248	83	100%

Referencing data on average energy consumption per household provided by Anspayaxw and Sik-e-Dakh, an estimated annual energy consumption profile was developed for each home. It was assumed that each household uses approximately 25,000 kWh of energy for heating and electricity per year, based on the data provided by the communities and information on provincial household averages.

Based on this profile, Table 4-5 below summarizes the estimated energy consumption by fuel source. In other words, the information in the table below shows the estimated energy consumption if the home was heated with the fuel source listed.

Table 4-5: Estimated Energy Consumption by Fuel Source

Fuel Source	Average Home's Energy Consumption	Unit
Electric	24,600	kWh
Fuel Oil	2,300	L
Wood	4,900	kg
Propane	3,500	L

Utilizing the "per home" energy consumption estimates shown in the table above, the energy consumption was calculated for all homes. In other words, these values estimate the total residential energy used in the community. This is summarized in Table 4-6 below.

Table 4-6: Estimated Energy Consumption – All Homes

Fuel Source	Anspayaxw	Sik-e-Dakh
Electric	12,200 GJ	4,100 GJ
Fuel Oil	200 GJ	100 GJ
Wood	9,100 GJ	3,100 GJ
Propane	400 GJ	100 GJ
Total	22,000 GJ	7,400 GJ

The total estimated energy consumption of the Regional Energy Plan participants is shown in Table 4-7 below. This represents the energy use baseline for the regional energy plan. Note that the units for all energy sources are in GJ, which allows us to compare the energy use from each source to one another.

Table 4-7: Total Energy Consumption – All Participants

Project Participant	Diesel-Generated Electricity (GJ)	BC Hydro Electricity (GJ)	Propane (GJ)	Wood (GJ)	Fuel Oil (GJ)
Case Study 1 – Stick Frame Home		100		100	
Case Study 2 – Log Home				200	
Case Study 3 – Bear Claw Lodge	3,300		1,000		
Madii Lii	27				
Anspayaxw		12,200	400	9,100	200
Sik-e-Dakh		4,100	200	3,100	60
Total	2,427	16,500	1,100	12,500	260

As shown in the table above, participants of the regional energy plan primarily rely on BC Hydro electricity and wood to provide their energy for space heating and electricity usage.

4.2 EMISSIONS BASELINE

Referencing the information presented in the tables above, a baseline greenhouse gas (GHG) emissions profile was developed. These emissions calculations were completed using the emissions factors shown in Table 4-8 below, while the results of the GHG emissions calculations are shown in Table 4-9 following.

Table 4-8: Emissions Factors[7]

Fuel Source	Emissions Factor	Unit
Diesel	2.705	kgCO2e/L
Propane	1.548	kgCO2e/L
Wood (Residential – 0% MC)	0.343	kg/kg
Wood (Residential – 0% MC)	19.07	kgCO2e/GJ
Wood Pellets[8]	14.00 – 23.30	kgCO2e/GJ
BC Hydro Electricity	0.00001067	tCO2e/kWh
Light Fuel Oil	2.653	kgCO2e/L

Table 4-9: GHG Emissions Profile by Fuel Source

Project Participant	Diesel-Generated Electricity (kgCO2e)	BC Hydro Electricity (kgCO2e)	Propane (kgCO2e)	Wood (kgCO2e)	Fuel Oil (kgCO2e)	Total (kgCO2e)
Case Study 1 – Stick Frame Home		400		1,200		1,600
Case Study 2 – Log Home		100		3,100		3,300
Case Study 3 – Bear Claw Lodge	233,600		59,500	700		293,800
Madii Lii	800					800
Anspayaxw		36,200	27,100	173,900	12,100	249,300
Sik-e-Dakh		12,100	9,100	58,200	4,100	83,400
Total	234,400	48,900	48,900	237,200	16,200	632,400

As shown in Table 4-9, Anspayaxw and the Bear Claw Lodge are the two project participants which account for the largest portion of the GHG emissions. This is largely due to high levels of diesel-generated electricity use at the Bear Claw Lodge, and significant wood use in Anspayaxw.

It should be noted that all project participants are actively working to find cheaper, more sustainable energy generation and heating solutions to reduce energy costs and lower greenhouse gas emissions.

The following charts summarize the results of the energy use and emissions baseline. As shown in Figure 4-1 below, BC Hydro-generated electricity is estimated to account for the highest portion of energy use in the region. Although BC Hydro-generated electricity accounts for an estimated 50% of energy consumption, it only accounts for 9% of emissions. This is due to the vast majority of BC Hydro electricity coming from hydropower sources. In comparison, diesel-generated electricity and wood respectively account for 8% and 38% of energy consumption but contribute to 32% and 43% of emissions in the rural Upper Skeena region.

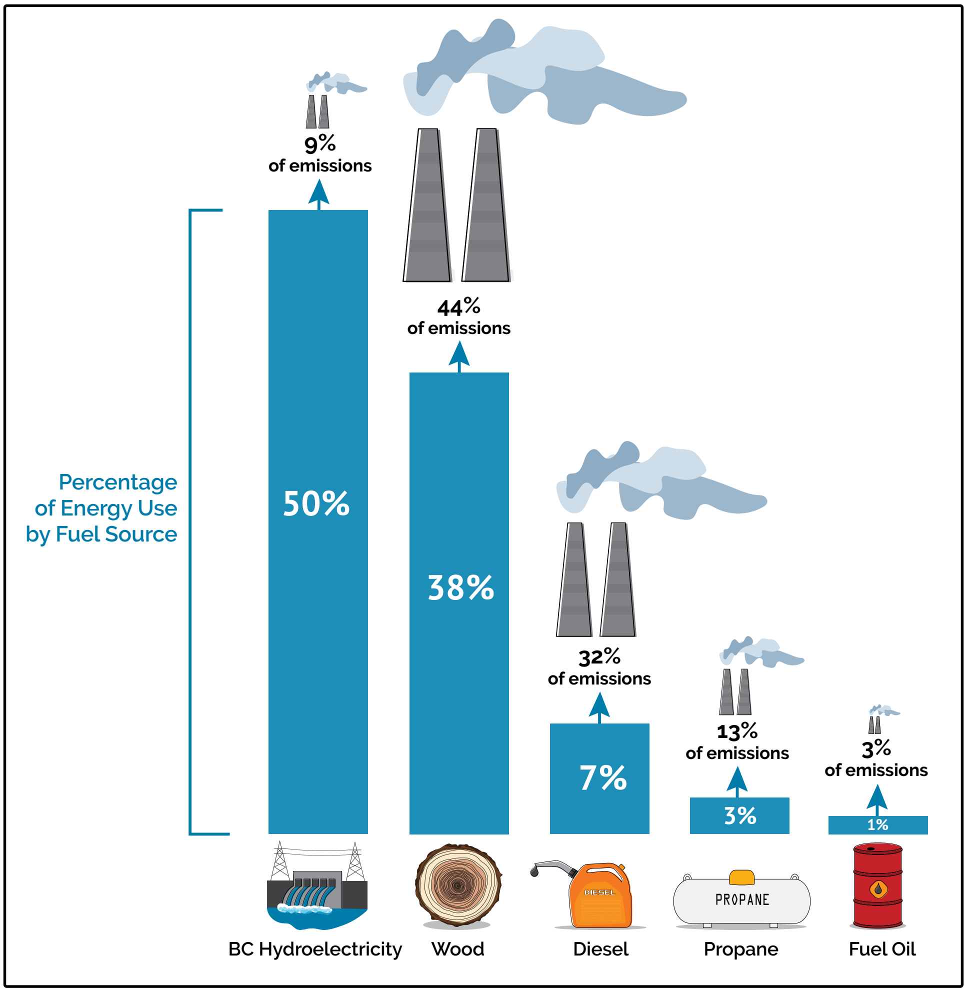


Figure 4-1: Summary of Energy Use (GJ) compared with Emissions (kgCo2e) by Fuel Source

A transition away from diesel-generated electricity could contribute to significant reductions in GHG emissions throughout the region based on the estimated energy consumption and emissions. It is worthwhile to consider the benefits of energy efficiency upgrades and retrofits to community residences with reference to wood burning. If the heat retention of houses is improved throughout Kispiox Village, it would lessen reliance on wood and decrease the need to burn as much in order to meet heating requirements.

4.3 COMPARATIVE ANALYSIS – ENERGY USE AND EMISSIONS

To elaborate on the energy use and emissions information described in the previous sections, a brief comparative analysis was completed to compare fuel use and associated emissions. The intent of this analysis is to provide a comparison of how much of various fuel types needs to be used to heat a "sample" home in the Upper Skeena and the resulting emissions. In other words, this analysis is intended to provide a comparison of the energy intensity and emissions of various fuels being used in the region.

Table 4-10 below summarizes the estimated energy consumption (GJ) for space and water heating 'per home' used in this assessment, which is referenced from Section 4.1. The emissions values used in this analysis are previously described in Table 4-8.

Table 4-10: Key Assumptions in Fuel Use and Emissions Analysis

Fuel Source	Average Home's Energy Consumption (GJ)	Estimated GHG Emissions (kgCO2e)
Electric	88.6	262
Fuel Oil		6,102
Wood[9]		1,681
Wood Pellets[10]		1,652
Propane		5,418

As shown in the table above, each home is assumed to use 88.6 GJ of energy for space and water heating. Based on this energy consumption, the estimated GHG emissions associated with the usage of each fuel source was calculated.

As shown above, a "sample home" using fuel oil or propane would emit far higher amounts of GHG emissions in comparison to a "sample home" using an identical amount of energy with electricity as the fuel source.

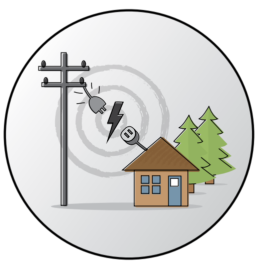
Although the use of electricity for space and water heating represents the lowest emissions option, reliance on electricity may result in a number of other energy challenges further described in the following section.

The Upper Skeena region frequently experiences power outages and brownouts, which pose a challenge to residents who rely on electricity for their heating, particularly during winter months.

5

5. REGIONAL ENERGY CHALLENGES

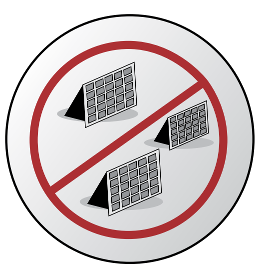
This section will outline the regional energy challenges that residents of the rural Upper Skeena face. These can be summed up as:



Unreliable Power Supply

Inadequate Support Network

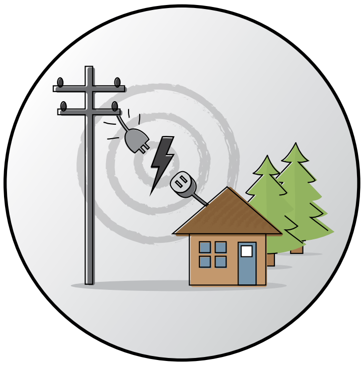
Reliance on Fossil Fuels



Lack of Clean Energy Opportunities

Significant Energy Costs

Additional details on each of these challenges are provided in the following sections.



5.1 UNRELIABLE POWER SUPPLY

One of the major complaints heard during conversations with Rural Upper Skeena residents and while gathering information for case studies was that the region's power supply is generally unreliable. This results in community members suffering from frequent power outages and brownouts throughout the course of the year. As a result, a common community priority has been the establishment of a reliable electricity supply.

The challenges of having a power supply that community members cannot depend on are not difficult to imagine. Power outages translate into considerable disruption for community members. This can include disruption of work, recreation, as well as critically important infrastructure and community functions. Apart from the nuisance value of such interruptions, this also imposes an additional financial and logistical cost on the community when in order to deal with power outages, they have to invest in alternate power supplies or emergency power measures.

For example, fridges and freezers shut down, resulting in spoiled food. This is frustrating not only in homes throughout the region, but also challenging in grocery stores and gas stations which sell perishable food.

Furthermore, this has direct implications for emergency management procedures for the community. If there is no reliable power source/supply, this can impact emergency management and potentially result in damage, injury and even loss of life.

Finally, in a community which faces severe cold and punishing winters, fluctuations in power supply means that community members have suffered from a loss of heating in the months where access to it is critical for their health and well-being. This is especially true for community members from the rural Upper Skeena where other sources of heating are not available. While other community members have access to additional sources of heating, none are as environmentally friendly and sustainable as electrical options. Therefore, the disadvantages of having an unreliable power supply also spill over into the realm of environmental sustainability and contribute to increased GHG emissions. Hence, it is of critical importance that the rural Upper Skeena gains access to a consistent, decentralized and dependable source of electricity – even if only as back up to the BC Hydro power grid.

5.2 INADEQUATE SUPPORT NETWORK

The rural Upper Skeena faces another challenge from the lack of a support network that will aid their transition to a sustainable energy future. This stems from several different factors; lack of energy literacy among residents of the region, lack of regional awareness regarding energy usage and GHG emissions, lack of a collaborative approach between various communities to date, and a dearth of information around climate change impacts associated with fossil fuel usage.

This is a complex, multi-layered problem with its different facets feeding into each other but essentially, this means that the rural Upper Skeena does not yet have the capacity to transition from their current energy mix to a sustainable, environmentally friendly, cost-effective energy future.

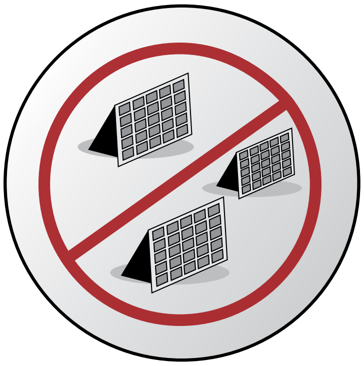
The lack of energy literacy causes insufficient adoption of energy efficiency and infrastructure upgrades. Without such literacy, the rural Upper Skeena cannot hope that our residents will be aware of measures like improving building envelope insulation, energy efficient construction, fuel switching and air sealing. Without the adoption of these measures, the same members cannot reduce the energy intensity of their residences and workplaces, leading to spiralling costs and increased emissions. The lack of such awareness also contributes to insufficient regional buy-in.

If community members are not aware of and educated on the efficacy and the advantages the above-mentioned adoption brings, it will be difficult to create support for the goal of a sustainable energy transition. Without adoption and support for energy efficiency and conservation measures, any community-scale renewable energy or storage projects that could be implemented will need to be large and potentially uneconomical. For example, if residents have the ability to reduce their energy usage by 40%, then there is potential for any energy or storage system to be 40% smaller, and therefore more affordable. Commitment to energy efficiency and conservation as a first step allows the implementation of community-scale projects for be significantly more effective in both reliability and affordability.

An additional disadvantage borne by the community is the loss of economic benefits that such a support network might bring. Energy literacy and efficiency measures lead to job opportunities for community members which directly impacts the economic health of the rural Upper Skeena. By not developing a collaborative support network, the rural Upper Skeena is missing out on this opportunity to augment its finances, reduce its GHG emissions and educate community members.

If the rural Upper Skeena achieves the sustainable energy future it aims towards, it is vital that the foundation for such a support network be laid. This support work may involve developing a culture around the use of renewable energy systems, the installation of energy retrofits and upgrades, and being conscious and aware of daily actions which could be taken to reduce energy use.

As explained further in Section 10.1, this could be initiated by hosting community outreach sessions to provide information and educational materials to regional residents. These sessions could be intended to support residents in understanding various technologies and options available to support the region in achieving energy goals. Engaging an energy champion will be critical to developing cohesive goals and energy-related objectives for the region.5.3



5.3 LACK OF CLEAN ENERGY OPPORTUNITIES

The rural Upper Skeena currently meets its power needs from a number of sources. For renewable sources, these include solar PV, biomass, and BC Hydro.[11] From non-renewable sources, this includes diesel generators, fossil fuels for space heating. Not only is meeting power needs from non-renewable sources financially challenging, but it also results in environmentally unsustainable behaviour since the usage of diesel generators and fossil fuels contributes significantly to GHG emissions within the community. With the current energy mix, diesel generators produce only 7% of the total energy used by project participants but are responsible for 31% of all emissions.

The lack of clean energy opportunities within the region give rise to the specific challenge of excess GHG emissions. This, if left unchecked, increases the rural Upper Skeena's culpability in contributing to dangerous environmental impacts[12] at a macro scale such as overall annual temperature rise, increased annual precipitation, more frequent and intense extreme weather events, heat waves and eco-system degradation.

Although the rural Upper Skeena is currently responsible for GHG emissions at a community scale, it is important to note that many other companies and organizations throughout British Columbia and Canada are responsible for significantly higher GHG emissions as a result of their operations. For example, the LNG industry and slash burning are two emissions-intensive industries which operate in the Northern British Columbia region.

In addition to environmental impacts, continued use of the above mentioned energy sources will also contribute to impacts to human health (injury and death due to extreme weather, respiratory and cardiovascular problems and cancers due to air pollution, mental health issues) and economic consequences (climate change affects various economic sectors such as agriculture, forestry, tourism and recreation, financial and operational stress on health and social support systems, damage to infrastructure from extreme weather).

As identified in a number of case studies within the region, in order to avoid contributing to these macro level changes, as well as reducing their own carbon footprint, numerous community members have identified reducing GHG emissions as a priority. Given the complete lack of clean, renewable energy generation sources within the community, this priority cannot be addressed without considering clean power projects as an integral part of the sustainable energy future that the rural Upper Skeena wants.

5.4 RELIANCE ON FOSSIL FUELS

Another community concern has been the reliance on fossil fuels for power generation. This is especially true in the case of the usage of diesel generators, propane, and fuel oil for space heating. Especially applicable to Wilp Luutkudziiwus' camp at Madii Lii and Bear Claw lodge, community members who are off grid, this reliance on diesel gives rise to several problems.

These include reliance on a fuel whose usage is an active pollutant compared to other options. Consequently, such usage leads to increased GHG emissions, in direct contradiction of the regions' goals to foster an environmentally friendly energy mix and reduce emissions. Diesel usage actively contributes to the total GHG emissions of the rural Upper Skeena and this has numerous social, economic and environmental impacts as detailed earlier.

In addition to being a source of increased GHG emissions, the usage of diesel generators also places additional burdens on community members. These generators must be maintained and serviced regularly in order to maintain efficiency. The systems are more prone to be unreliable since a host of issues can affect their performance, leading to more problems for community members. This has resulted in community members demanding low maintenance energy systems with a higher degree of reliability to meet their needs.

Reliance on fossil fuels for meeting the community's energy needs places the rural Upper Skeena at the mercy of volatile energy markets and fuel costs, which are in perpetual flux due to a wide variety of factors out of residents of the rural Upper Skeena's control. This has several cascading effects such as being unable to plan accurately for future needs, inefficient/inaccurate cost forecasting, vulnerability from potential fuel shortages and wide fluctuations in costs depending on fuel prices.

5.5 SIGNIFICANT ENERGY COSTS

The previous subsection leads us neatly to this regional challenge. Due to the usage of fossil fuels, lack of energy efficiency awareness measures, and inefficient design, community members incur a significantly higher cost for their energy usage.

Diesel generators are not highly efficient sources of power given their fuel consumption. In an era of constantly increasing fuel prices, this places a considerable financial weight on community members who are reliant on diesel for power generation.

The lack of awareness regarding energy efficiency measures and demand side management, coupled with inefficient building design also contributes significantly to the problem of excessive energy costs. Because community members are unaware of various energy saving measures, their residences are not properly insulated and/or constructed at a time when energy efficiency was not a priority, leads to much higher energy costs for the rural Upper Skeena.

This was found to be a common thread amongst all the case studies conducted; that community members place a very high priority on reducing their energy costs. Thus, it is important for the rural Upper Skeena to address the sources of these excessive costs and cut down community member's energy bills. While energy awareness is crucial, it remains only part of the solution. Once residents are aware of the numerous demand side management measures, they can undertake to reduce excessive costs, it is equally important that they have access to financial supports to aid them in their transition towards more energy efficient, well-insulated homes. It is for this purpose that a list of funding options for Kispiox community members has been compiled in Section 8.2.

It should be noted that although many funding opportunities provide support to develop new homes and community buildings, the cost of building a more efficient structure can be cost prohibitive and can force communities and organizations to advance less efficient building options. As such, many homes and buildings require efficiency upgrades sooner in their lifespan than a more efficient option – resulting in higher energy costs for community members and inflated retrofit costs.

As discussed in Section 10.1, a potential solution to support communities and residents in addressing this issue may be to offer an "energy mortgage" or funding and information support program. This program could allow communities and regional residents to complete efficiency upgrades with funding from their "energy mortgage", which could then be repaid over time, similar to a typical loans or mortgages.

5.6 CHALLENGES TO MADII LII

Madii Lii is a cultural basecamp for Wilp Luutkudziiwus located at the entrance to the Madii Lii territory within the Gitxsan Nation (15 km from Hwy 16 on the Suskwa Forest Service Road). Madii Lii is fully off grid with no connection to the BC Hydro power grid. The camp has a main lodge with a kitchen and meeting hall, greenhouse, smokehouse, 3 cabins and several outbuildings.

The camp is currently powered by a 5,000 W diesel fueled generator, hardly meeting current power needs and is not a sustainable long-term energy solution. Besides the emissions from the generator, it is loud and underpowered. The camp is 28km away from the closest fuel station.

The goal for Madii Lii is to acquire solar infrastructure with sufficient batteries to meet power needs and an 8,000-10,000 W high efficiency generator with ability to tie in as a solar back up. A solar system design to meet the camp's needs has been developed, which is provided in Appendix D.

One of the challenges for Wilp Luutkudziiwus to implement the aforementioned design and meet its solar needs is access to funding. Further avenues for sustainable energy can be explored, for example, micro-hydro systems as Madii Lii have direct access to the Natlan Creek which has the right conditions for a micro-hydro system to be installed.

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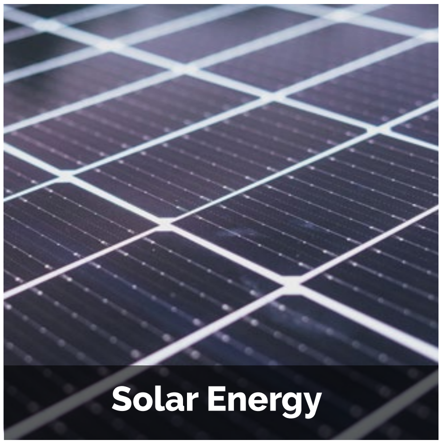
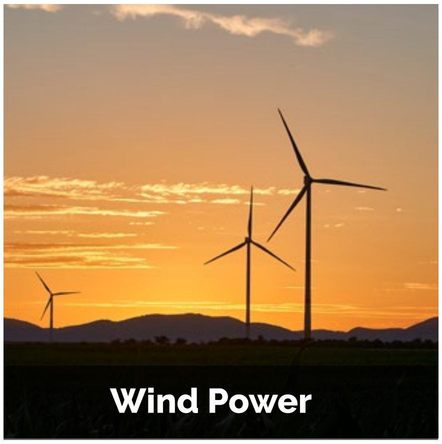
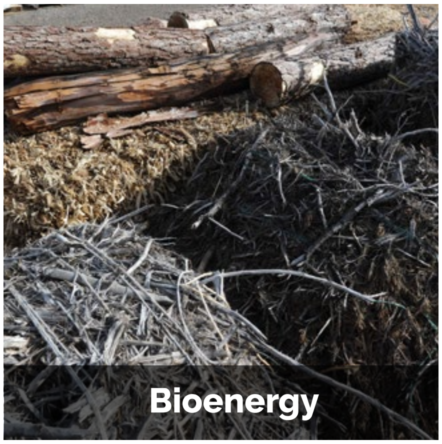
6. LOCAL RENEWABLE ENERGY ALTERNATIVES

This section will elaborate on the assessment of potential local renewable energy alternatives available to the Rural Upper Skeena. It will cover:


Solar Energy

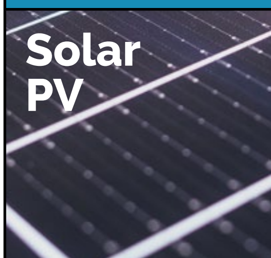
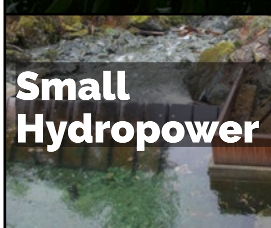
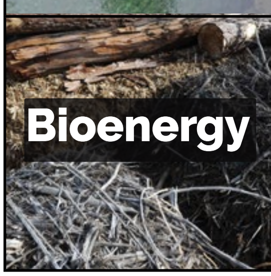

Small Hydropower

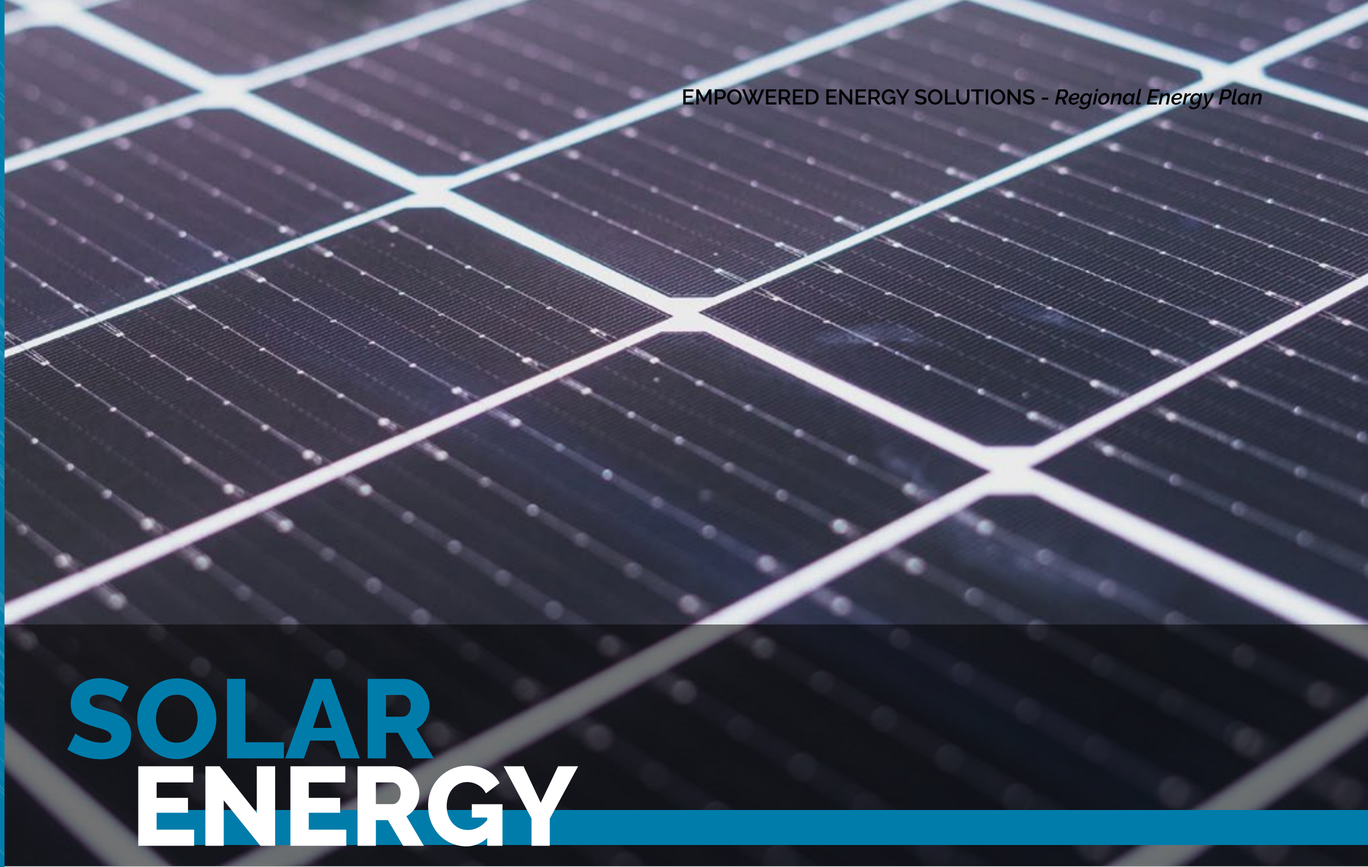

Wind Power


Bioenergy

At a high level, the feasibility of each renewable energy technology can be summarized as follows in Table 6-1 below.

Table 6-1: Feasibility of Renewable Energy Technologies in the rural Upper Skeena

Renewable Energy Technology	Strength of Resource in Region	Typical Cost of Development	Typical Regulatory Considerations	Key Findings and Potential Next Steps	GHG Emissions from System Operation
	Moderate (Average 3.5 kWh/m2 annually, though challenging to generate electricity in winter with lower sunlight hours)	Low to moderate	Low	Potential opportunity for development in the rural Upper Skeena, particularly with a backup source or a hybrid system.	None
	Low (Average 3-3.5 m/s, no active wind tenures in region)	Very high (Large-scale system) Low to moderate (Small-scale system)	Significant, particularly if there are no active wind tenures (Large-scale system) Low (Small-scale system)	Limited opportunity for larger-scale development in the rural Upper Skeena. Opportunity for smaller-scale development in the rural Upper Skeena as a part of a hybrid system.	None
	Low (No active water licenses for power generation in region)	High	Significant, particularly if there are no active water licenses for power generation	Limited opportunity for larger-scale development in the rural Upper Skeena	None
	High (Significant fuel availability for low cost)	Low (Small-scale or decentralized system) High (Large-scale or centralized system)	Low	Potential opportunity for development in the rural Upper Skeena	High due to burning wood pellets or waste for feedstock



6.1 SOLAR ENERGY

OVERVIEW

Solar PV systems capture energy from the sun and convert it into electricity for use in homes and buildings. Grid-tied systems (as the one shown in Figure 6-1) have the ability to send excess power produced by solar installations to the BC Hydro grid. Off-grid systems require energy storage solutions, such as batteries, to capture excess solar power produced by the panels.

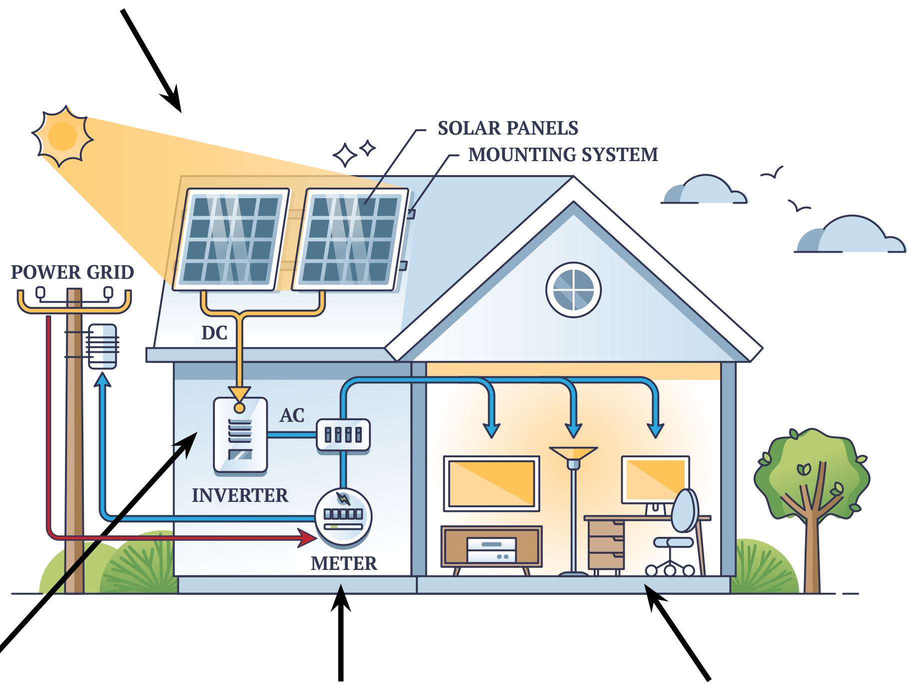
Each solar PV system is sized and developed to meet a site's specific requirements. This includes consideration of:

System connection to the grid

- Battery storage requirements (when off grid)
- Site (roof or unobstructed ground) surface area
- Azimuth (building orientation)
- Roof slope
- Site shading; and
- Energy demands of the building

Figure 6-1 below provides an overview of the equipment required for a grid-tied system. As some community members are connected to BC Hydro's grid, the image below represents a solar installation similar to those which could be installed in the rural Upper Skeena for residents with a BC Hydro connection.

1. **Solar Panels:** *Sunlight falls on solar panels during daylight hours. The solar panel converts the sun's energy into Direct Current (DC) electricity which is sent to the inverter.*



2. **Inverter:** *The inverter converts the Direct Current into Alternate Current (AC) electricity which can then be readily used for household consumption.*

3. **Bi-Directional Meter:** *If there is more solar production than consumption at any given time, excess electricity is sent to the utility company through the bi-directional meter. The meter tracks how much energy is consumed or produced and sent to the grid.*

4. **Power for a Building:** *After travelling through the bi-directional meter, solar power can be used to power lights, plugs, and appliances in the building; and*

5. **Utility Power:** *When the building's demand exceeds solar production, utility power is provided.*

Figure 6-1: Operation of a Grid-Tied Solar PV System

ROOF-MOUNTED SYSTEMS

Installed on the roof of a building, roof-mounted solar PV systems are connected directly to a building's roof and existing electrical system and provide power directly to the building as required.

These systems are specific to each building, and account for a roof's slope, surface area and azimuth, along with the other factors outlined above. Anticipated wind and snow loads are also considered when designing a roof-mounted solar PV system.

As shown below, Figure 6-2 provides an example of a roof-mounted solar PV system.

Figure 6-2: Roof Mounted Solar PV System

GROUND-MOUNTED SYSTEMS

Ground-mounted solar installations utilize space afforded by fields and open areas, as shown in Figure 6-3 below. Unlike roof-mounted systems, ground-mounted installations can be constructed as steady (immobile) systems, or as tracking systems which follow the sun throughout the day or seasonally.

A ground mounted system may be installed in cases where a roof is not suited for a solar installation. This may occur when:

- The roof is old or in poor condition
- The roof area is insufficient to support a cost-effective solar installation
- A roof does not have the correct azimuth for solar energy production, such as when a roof is facing north
- Shading occurs from a tree or building in proximity to the installation
- A resident may face challenges in accessing the roof for cleaning and/or maintenance of the panels

Figure 6-3: Ground-Mounted Solar PV System

The foundations of ground-mounted systems will vary depending on the ground and soil type at the site. Due to the additional mounting and foundational equipment required for ground-mounted systems, these installations are typically more expensive than a roof-mounted system.

SOLAR PV PROJECTS AND BC HYDRO NET METERING REGULATIONS

As of February 14, 2019, BC Hydro indefinitely suspended its Standing Offer Program (SOP). This program allowed larger-scale (up to 15 MW) renewable energy projects to sell their generated electricity to BC Hydro through a long-term electricity purchase agreement (EPA). The suspension of the SOP constrains / eliminates the viability of most clean energy project development opportunities in BC.

Since the suspension of the SOP, BC Hydro's only active electricity procurement program is the Net Metering Program. The regulations of the Net Metering Program require participants to build renewable energy projects which are no larger than 100 kW and only supply power to a single home or building per year.

Should participants build a renewable energy system which produces more electricity than the building uses on an annual basis, the surplus electricity is sold to BC Hydro at the market rate via the BC Hydro Net Metering Program. The market price for annual surplus electricity is calculated on January 1 every year and is based on the daily average wholesale electricity prices in Mid-Columbia for the previous calendar year, converted to Canadian dollars using the average annual exchange rate from the Bank of Canada for that year[13].

Due to the high installation cost of solar PV systems and the lower rate of electricity sold to BC Hydro, the most cost-effective option for a solar PV installation is to size the project to meet the annual electricity demands of the home or building on which it is installed. If desired, a solar PV installation which produces more than a building's annual electricity demand could be constructed, though a more cost-effective option is to size the system to meet a building's annual electricity demands.

SOLAR RESOURCE OPPORTUNITY REVIEW

The success of a solar PV project at a site depends on multiple factors, including:

- Solar radiation
- Local climate conditions
- Site shading restrictions
- Accessibility to the grid for interconnection
- Electricity rates

Of most importance, the location and orientation of the solar array are crucial in assessing the potential viability of a solar PV project and its expected energy production. Typically, a solar PV installation will produce the greatest amount of power if it is facing due south at an angle equivalent to the site latitude, but this varies depending on the geographical location of the installation and site shading restrictions.

To assess the viability of solar PV projects in the rural Upper Skeena, a preliminary assessment of solar resources has been completed. This includes referencing NRCan data and BC Hydro's Integrated Resource Plan Solar Potential Map, as illustrated in Figure 6-4 below.

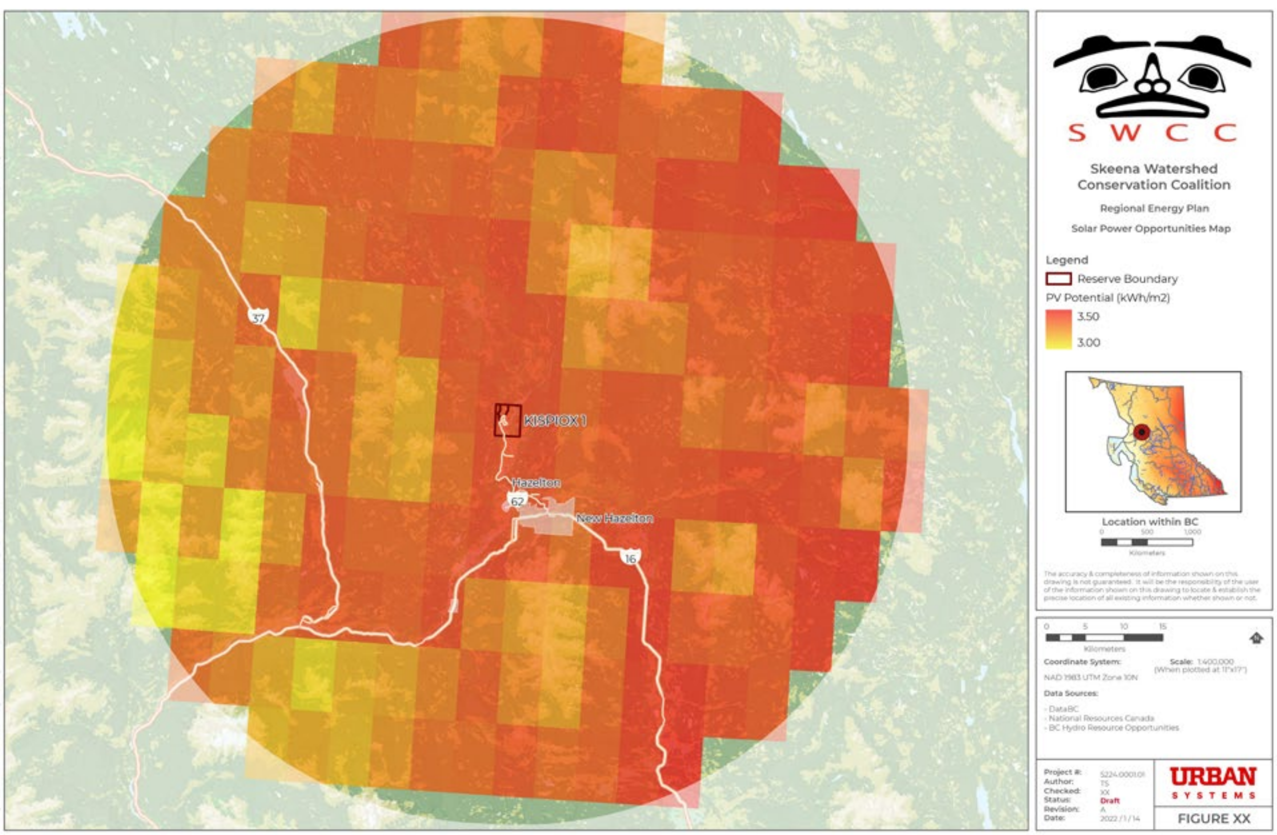


Figure 6-4: Solar Energy Potential in the Rural Upper Skeena

SUMMARY OF SOLAR PV OPPORTUNITIES

Should individuals be looking to develop a solar PV project, they should consider several aspects which can greatly influence the feasibility of the project – both in terms of energy generation and financial feasibility of the project. These considerations are outlined below.

SITE REQUIREMENTS

This factor depends on the actual amount of available sunlight – both direct and scattered – and how that figure compares to the electricity required from the proposed installation. To help make this determination, solar systems output is typically measured in kilowatt-hours per square meter (kWh/m2) or watts per square meter (W/m2). It is also vital to note that PV panels can vary in their efficiency, so the specific efficiency needs to be factored in when comparing potential configurations and other solution considerations.

Key questions include:

- How much surface area will be required to generate the desired amount of power?
- Will that be available within the proposed site?
- Will a system of that required size and surface area be financially viable? Both to cover the costs initially and to recoup that investment over time?

PLANNING REQUIREMENTS

There are two major solar energy systems:

1. Roof-mounted systems are installed on the roof of a building and connected directly to the building's existing electrical system. These systems provide power to the building first, any additional power required would be pulled from the grid and any excess power produced would be pushed to the grid. These systems are designed to account for a roof's slope, surface area and azimuth, along with the other factors outlined above. Anticipated wind and snow loads are also considered when designing a roof-mounted solar PV system.

2. Ground-mounted systems: The foundations of ground-mounted systems will vary depending on the ground and soil type at the site. Due to the additional mounting and foundational equipment required for ground-mounted systems, these installations are typically more expensive than a roof-mounted system.

With these considerations in mind, along with the information presented in the map above, it is apparent that the solar PV resource in the region is moderate, with an average solar PV potential of 3.5 kWh/m2. Referencing this value and the information in the map shown above, Table 6-2 below provides a high-level analysis which demonstrates the average solar PV energy generation for varying sizes (capacities) of solar PV systems which may be installed in a home or community.

The sizes of systems presented in the table below represent three key solar PV system capacities which may be of interest to a typical sized home / resident of the rural Upper Skeena region.

Table 6-2: Summary of Solar PV Opportunities in Rural Upper Skeena

Key Questions	4 kW System	14 kW System	30 kW System
Why was this system selected?	This system could likely fit on the roof of an average sized home in the region.	This system could likely offset most of an average home's annual electricity consumption.	This system could likely fit on the ground beside a small business or community building.
How many kWh of electricity could this system generate per year?	Approximately 4,200 kWh per year. This may offset 20-30% of an average home's annual electricity consumption.	Approximately 15,000 kWh per year. This may offset nearly all (80-100%) of an average home's annual electricity consumption.	Approximately 31,500 kWh per year. This may offset a moderate portion (40-60%) of an average small business or community building's annual electricity consumption.
How much would a solar installation of this size cost?[14]	Approximately $10,000 to install.	Approximately $35,000 to install.	Approximately $75,000 to install.
How much could a system of this size save on BC Hydro costs?	This could support a home in saving approximately $400 per year on BC Hydro bills.	This could support a home in saving approximately $1,400 per year on BC Hydro bills.	This could support a small business or community building in saving approximately $3,000 per year on BC Hydro bills.
Given current BC Hydro rates, how long will this system take to "pay off" without grant funding?	25 years	25 years	25 years
Given current BC Hydro rates, how long will this system take to "pay off" with funding support?[15]	15 years	21 years	23 years

To further identify the potential area available for solar PV generation throughout the study area, a solar potential "map" is under development. This interactive tool will allow users to see the solar potential of each home in a community and understand the potential annual electricity generation should a project of this capacity be developed.

Additionally, solar data is currently being collected for the Upper Skeena region. The following link provides information on how much electricity is currently being generated, and has previously been generated over various time periods. Similar generation values were used in the development of the solar map referenced above.

Solar monitoring link: http://egauge18154.egaug.es/index.html

6.2 SMALL HYDROPOWER

The following section discusses small (run of river) hydropower generation opportunities throughout the project study area.

OVERVIEW

Hydropower projects utilize the kinetic energy of water (produced from the movement of water down a slope) and convert it into electricity. Each project is composed of the following major components:

- Headworks: The pond and structure at the head (top) of the hydropower project, used to divert water from a river, stream, or canal into the intake structure
- Intake structure: The structure used to collect / withdraw water from the source, used to filter or remove any debris from the water prior to it entering the penstock
- Penstock: The water from the intake structure flows into / through the penstock and down the gradient before reaching the powerhouse
- Powerhouse: The powerhouse contains turbines which convert the water's energy into electricity
- Tailrace: This structure allows water to flow back into the stream; and
- Transmission line: The transmission line transports the power produced in the powerhouse to the main BC Hydro grid

A general configuration for a small hydropower generation project is illustrated in Figure 6-5 below.

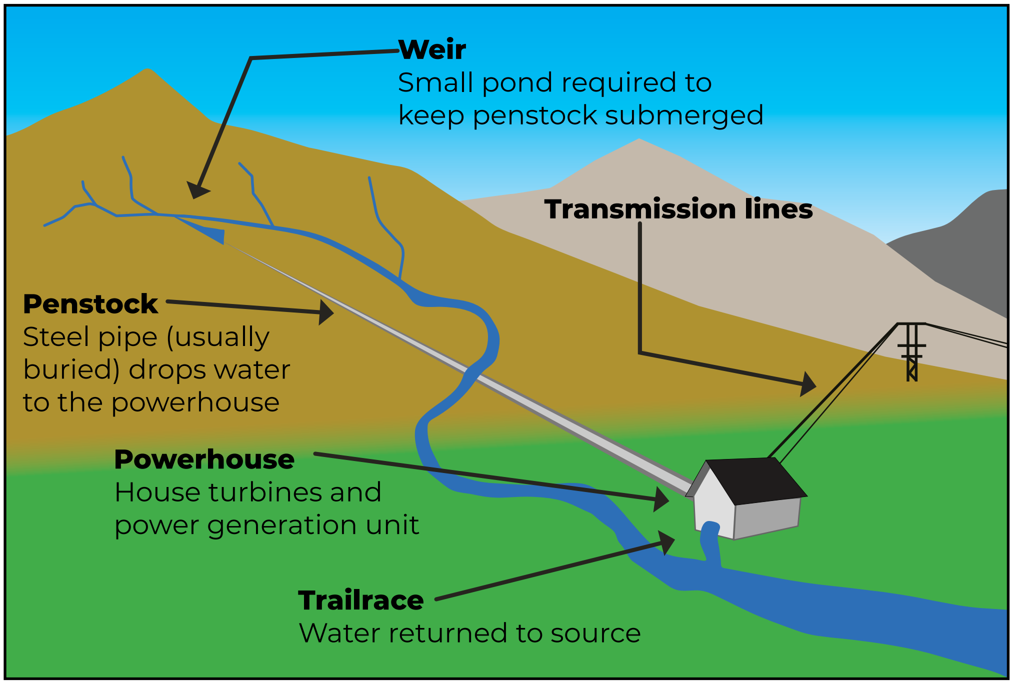


Figure 6-5: Small Hydropower Generation Process

The feasibility of a small hydroelectric project is dependent on many factors, with the two largest factors being the availability of stream flow and the elevation change (head). Flow can vary seasonally, and this primarily dictates the levels of energy generated. The feasibility of a project is also largely dependent on specific site conditions, such as proximity to the electrical grid, ease of access to the site, and local topography.

Environmental impacts associated with the development of a small hydropower project should also be considered. These impacts, outlined below, can vary significantly depending on the type of hydropower project, the size, and its location.

- Flooding of upstream areas: A small dam or diversion weir is typically required to ensure that the intake structure remains covered.
- Fluctuations to downstream water levels: An upstream diversion can cause fluctuations in downstream water levels, which may impact fish habitat; and
- Fish habitat / barrier: Fish travelling upstream require a system or structure to allow for safe passage over the project.

Typically, the development of a small hydropower project takes between two and five years. Many environmental and technical studies need to be completed in order to complete the project design work, and several provincial and federal regulatory approvals are required prior to construction.

SUMMARY OF SMALL HYDROPOWER OPPORTUNITIES

Should an individual or community wish to develop a small-scale hydropower project, a number of site considerations need to be taken into account. These are described below.

SITE REQUIREMENTS

The head height and flow of water available determine the amount of power that can be generated. When planning a hydropower plant, attention needs to be paid to the seasonal and yearly differences in water availability.

ENGINEERING & INFRASTRUCTURE REQUIREMENTS

Micro – and pico – hydro power plants are often best suited for isolated areas where there is no electricity grid. Off the grid power plants require local load controlling to stabilise frequency and voltage of supply. They have the advantage that they are generally designed for single households or small villages and can be developed with local materials and labour. For small pico-hydro turbines, the turbine/generator set can be bought as a module "off the shelf", whereas from micro-power plants upwards the turbines are especially designed for the location.

PLANNING REQUIREMENTS

To proceed with a small hydropower scheme, it is necessary to obtain the authorization to utilize all the land concerned and it is important to find out how contractors will access the different areas of the hydropower site with the necessary equipment. It is therefore wise to approach the applicable parties with interests in the lands and resources (other Indigenous Communities, Government of BC, and Government of Canada) as well as relevant landowners at an early stage to identify any objections to the proposed project and to secure access to the land.

ENVIRONMENTAL CONCERNS

Small hydropower systems impose a smaller impact than larger systems on aquatic ecosystems and local communities. However, like all forms of hydro-based generation technologies, they need to be carefully vetted because they cannot completely prevent stresses on ecosystems and human well-being.

Environmental impacts, outlined below, can vary significantly depending on the type of hydropower project, the size, and its location.

Flooding of upstream areas: A small dam or diversion weir is typically required to ensure that the intake structure remains covered.

Fluctuations to downstream water levels: An upstream diversion can cause fluctuations in downstream water levels, which may impact fish habitat

Fish habitat/barrier: Fish travelling upstream require a system or structure to allow for safe passage over the project. Hydropower projects should not be constructed in fish bearing streams, apart from in a small number of cases where significant mitigation measures are implemented, and appropriate regulatory bodies are in approval.

As discussed above, hydropower projects are subject to several limitations. In particular, BC Hydro does not have an active or current energy procurement program, thus eliminating the viability of such opportunities which are greater than 100 kW in capacity. Smaller-scale projects (less than 100 kW) are subject to a number of environmental and planning requirements, including securing a water license for power generation purposes.

For example, Section 3.0 discussed micro hydro opportunities that were investigated by case study participants. These participants had a number of conversations with regulatory bodies regarding the process to develop a micro hydro project. As a result of these conversations, it was shared that the development of a potential micro hydro project requires the resident / participant to secure a water license for power generation and demonstrate that the creek is not fish bearing prior to applying to BC Hydro's net metering program. It is understood that it can be challenging to secure a water license for power generation (even if the project will be at a micro-scale), which could limit the development of potential micro hydro projects in the Upper Skeena.

6.3 WIND POWER

The following section discusses wind power project opportunities throughout the rural Upper Skeena.

OVERVIEW

Wind power projects convert the energy in the movement of the wind to electricity. The feasibility of a wind energy project is extremely dependent on the wind speeds at the proposed project location and on the overall project development costs.

The major components of a wind energy system include:

- Rotor and blades: Convert wind energy into mechanical energy in the rotor shaft
- Gear box: Matches the rotor shaft speed to the generator
- Tower: Supports the rotor above the ground, elevates the rotor and blades to capture higher wind speeds
- Foundation: Supports the tower
- Control system: Starts and stops the wind turbine

In addition to the components outlined above, road access and grid connection needs to be established to the site / project. The infrastructure required to construct, transport, and service the turbines requires road access, which can be challenging given the size of these components. Grid connections, in some cases, may require a transmission / power line to be built over a long distance, resulting in significant capital costs as well as the need for significant environmental approvals.

Shown below, Figure 6-6 depicts the major components of a wind turbine.

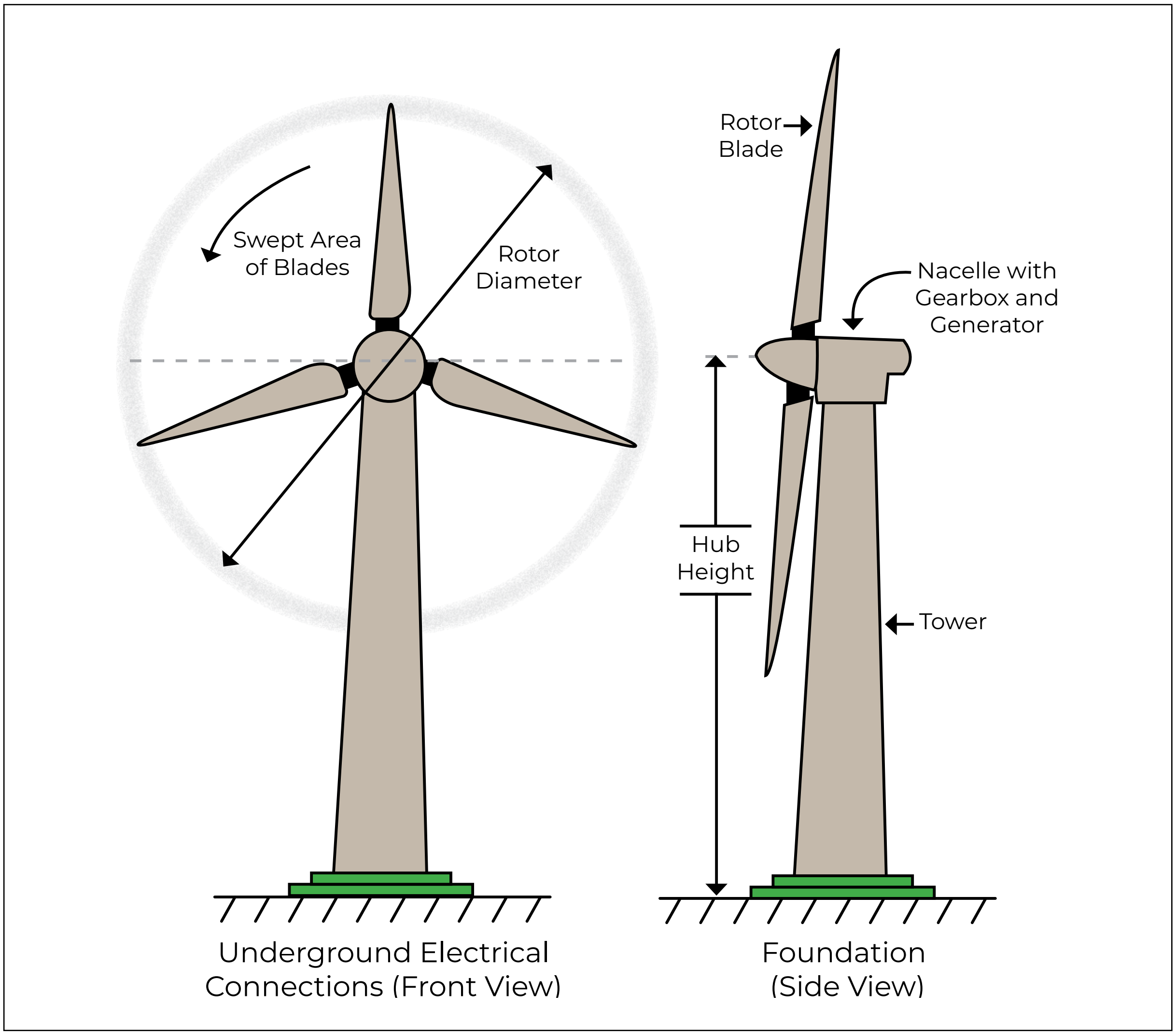


Figure 6-6: Major Components of a Wind Turbine

Wind turbines are available at large scales, with a capacity of 500 kW to 10 MW, and at smaller scales, with a capacity of 200 W to 100 kW. Additionally, micro wind projects can be installed on homes and properties. Many of these projects can be installed at a low to moderate cost, and could be integrated with other renewable energy technologies (such as solar PV) to develop a hybrid system.

FEASIBILITY AND OPERATIONAL NECESSITIES

SITE REQUIREMENTS

The amount of energy generated by a wind turbine depends on:

- Air density (mass per unit volume)
- Air speed
- Area of the rotor
- Area of the blades

Ground conditions for the siting of wind turbines also need to be considered such as soil stability, site drainage and hydrological effects, such as water supply and quality and watercourse crossings. In addition to the components outlined above, road access and grid connection need to be established to the site / project. The infrastructure required to construct, transport, and service the turbines require road access, which can be challenging given the size of these components. Grid connections, in some cases, may require a transmission / power line to be built over a long distance, resulting in significant capital costs.

PLANNING REQUIREMENTS

To help determine the suitability of the site for wind energy system, an estimate of the site's average annual wind speed needs to be determined. The wind resource can vary significantly over an area of just 1 square mile because of local terrain, local structures, and vegetation influences on the wind speed and flow. The siting also needs to consider zoning, permitting, and covenant requirements.

ENVIRONMENTAL CONCERNS

Wind turbines cause noise pollution as they rotate and visual problems to some people. During the turbine's life cycle, there are instances where there are greenhouse gas emissions and the release of waste that slightly contributes to pollution and climate change. The instances in the life cycle include manufacturing, material composition, transportation, installing, maintenance, and decommissioning. Installation of wind turbines calls for vegetation and forest clearing that can result in soil erosion, change of micro-climate, loss of animal habitat, and uncompetitive use of land. Additionally, wind turbines pose a risk to flying animals like bats and birds due to collision with the rotating components of the turbines.

WIND POWER OPPORTUNITIES ASSESSMENT

The development of a wind energy project typically includes extensive studies on wind resources at the site, the acquisition of permits, design and specification of equipment, equipment purchase, construction and commissioning.

An opportunities assessment was completed to determine if viable wind development opportunities exist within the Rural Upper Skeena. To identify such opportunities, BC Hydro's 2013 Resource Options Report (ROR) and the Ministry of Forest, Lands and Natural Resource Operations' database for wind tenures was referenced. Figure 6-7 below shows the wind energy potential in the Rural Upper Skeena region.

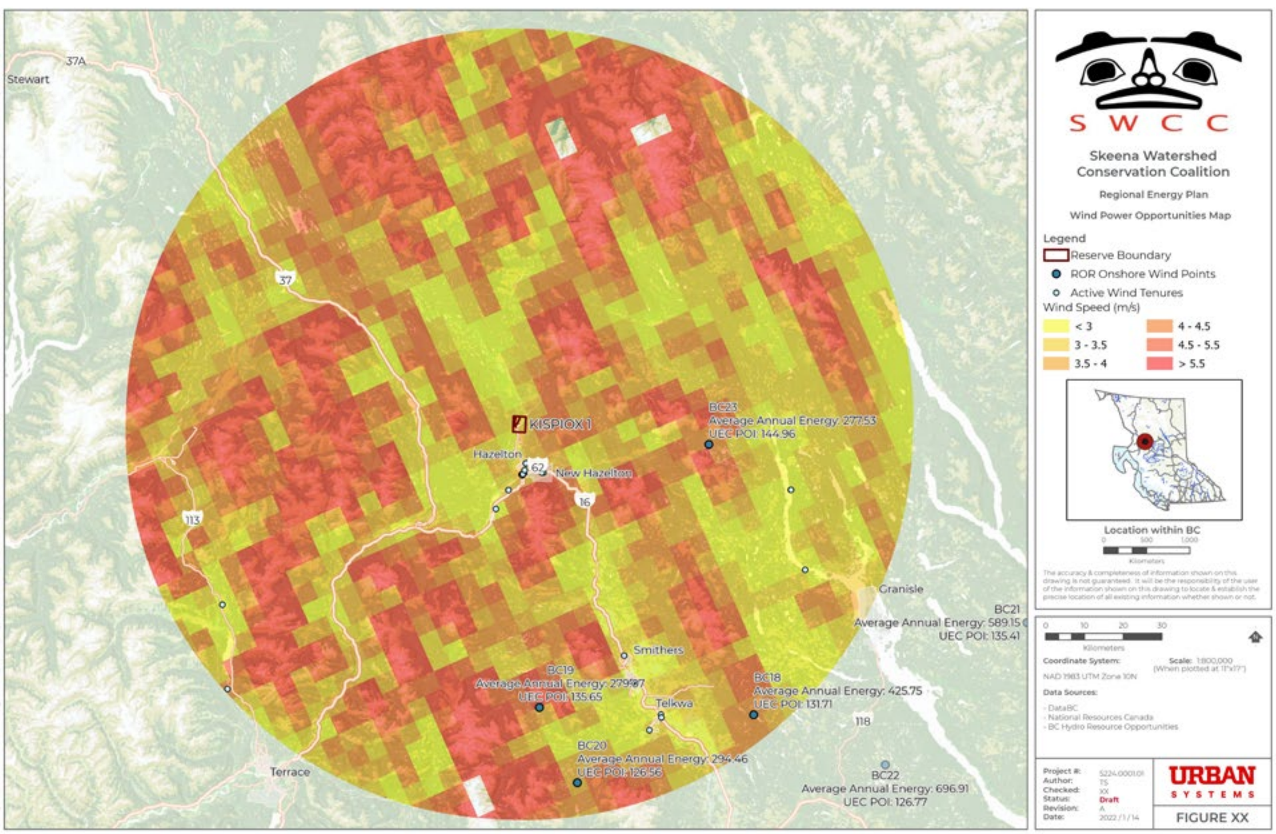


Figure 6-7: Wind Energy Potential in the Rural Upper Skeena Region.

6.4 BIOENERGY

The following section provides an overview of bioenergy project opportunities and how the technology operates.

OVERVIEW

Biomass energy systems are a form of renewable energy technology which burns biological fuel sources for heat and power. During its life cycle, organic matter like trees and plants collects energy from the sun in a process called photosynthesis. As the organic matter – called biomass – decomposes or is burned, that stored energy gets released as biomass energy.

- A biomass energy system has the following components:
- Fuel storage: The biomass system requires a location for wood pellets or chips to be kept dry.
- Biomass boiler: The biomass boiler burns the fuel and converts it to heat and / or
- power.
- Heating liquid storage: The heating liquid requires a storage location when not in use.
- Heating liquid distribution system: The heating liquid circulates through the pipes connected to each building, providing heat for each customer.
- Energy transfer station: The heating liquid flows through the energy transfer stations, allowing the energy to be used by the buildings.

COMBINED HEAT AND POWER (CHP) SYSTEM

Electrical and thermal energy (heat) can be efficiently generated through a bioenergy combined heat and power (CHP) system. A CHP system has the ability to produce a portion of a building's (or network of buildings') electricity requirements and can fully or partially displace the reliance on fossil fuels for heating.

Typically, CHP systems will be connected to a number of buildings, which are then supplied with heat and power from the centralized system. The CHP unit burns wood chips or pellets to create thermal energy and electricity for the buildings.

A biomass CHP system consists of the following major components, each of which were described above. In addition, each of these components are pictured in Figure 6-8 below:

- Building heating system (furnace)
- Energy transfer station
- Heating liquid distribution system
- CHP unit
- Electrical grid connection

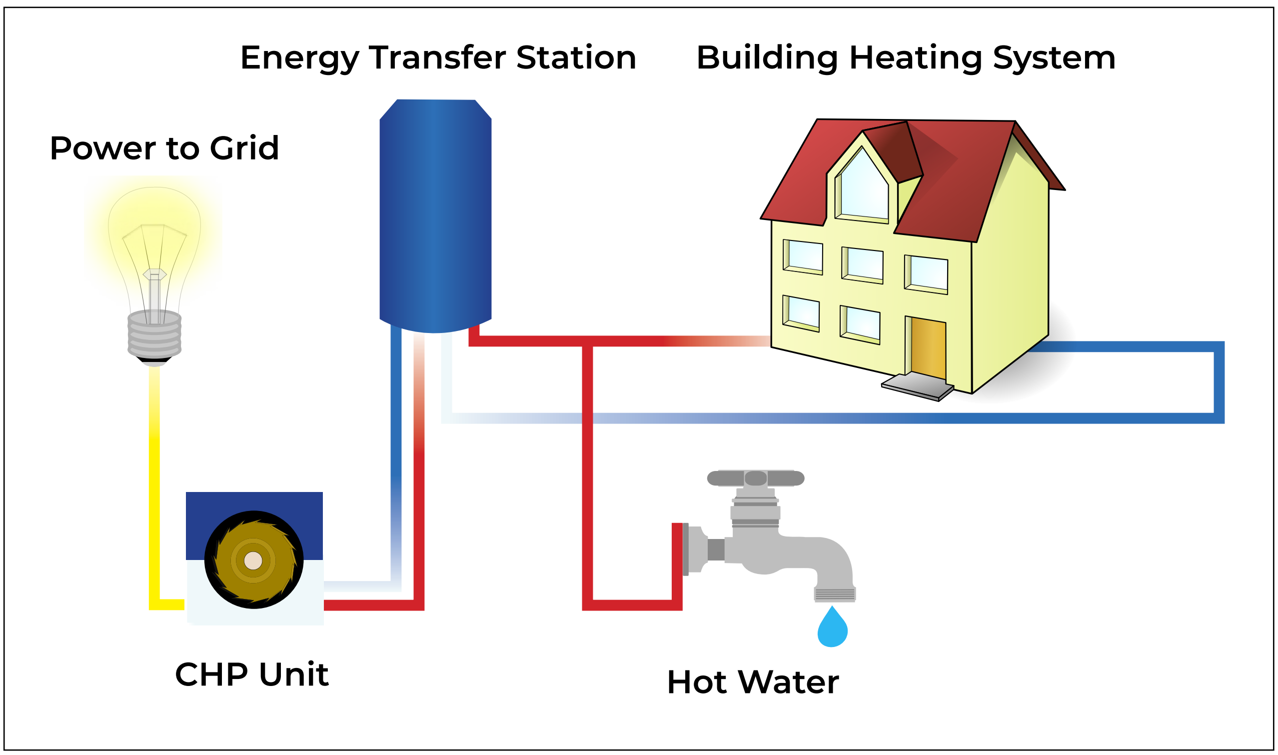


Figure 6-8: Summary Overview of a CHP System

DISTRICT HEATING SYSTEMS

District heating system (DHS) projects provide heat for buildings connected to the network. Biomass heat-only systems typically have higher capital costs than conventional heating systems; however, cost savings are often realized over time (e.g., fuel cost savings). A typical biomass DHS includes the following major components, as depicted in Figure 6-9 below:

- Building heating system (furnace)
- Energy transfer station
- Heating liquid distribution system
- Boiler

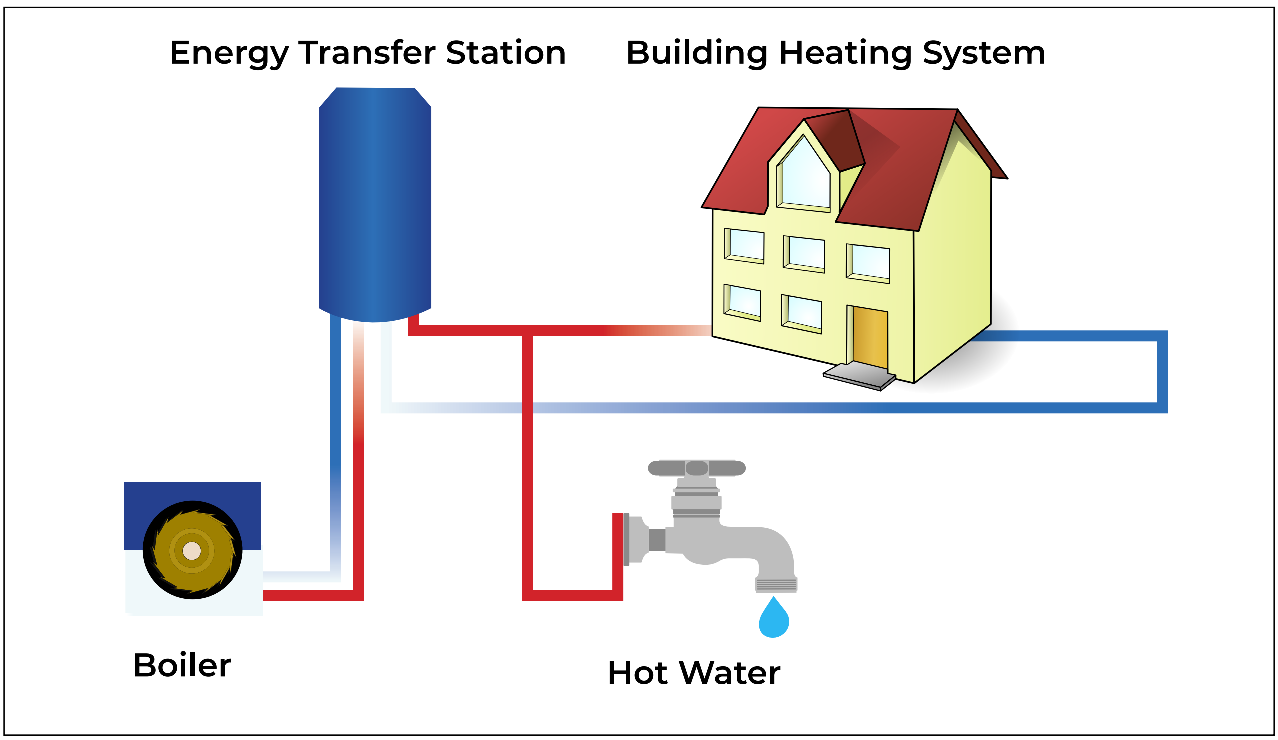


Figure 6-9: Summary Overview of a Biomass DHS

FEASIBILITY AND OPERATIONAL NECESSITIES

SITE REQUIREMENTS

A biomass energy plant requires an industrial sized site[16] of approximately 2-40 acres, along with a reliable water supply and sufficient supply of biomass fuel to maintain a consistent energy output. A network of insulated pipes is required to convey hot water away from the installation, other district heating systems use steam or thermal oil to distribute heat. For district heating to be viable, a high concentration of clustered target buildings needs to be present.

PLANNING REQUIREMENTS

The development of a bioenergy project requires the identification of a secure and sustainable fuel source. The most common biomass fuel sources used in bioenergy projects include:

- Wood pellets
- Wood chips
- Logging and mill residues and wastes
- Wood from non-marketable timber and associated wastes
- Accessibility to the grid for interconnection
- Electricity rates

It is crucial for the success of any DHS that a steady, preferably local supplies of biomass be available. This can include secondary wood product manufacturers, waste wood from sawmills, logging slash, clean construction and demolitions waste or farms. Ideally, a long-term supply contract from one or several suppliers should be negotiated to ensure an uninterrupted supply of fuel. Distance from fuel source to biomass facility is critical to project feasibility and supply contract success. Transportation of wood fuel is often the largest limiting factor in biomass fuel supply.

Another factor that needs to be kept in mind is whether any major modifications need to be made to buildings, services or processes in order to accommodate a district energy system.

ENVIRONMENTAL CONCERNS

Bioenergy is a unique type of renewable energy since unlike solar, wind or hydro, generating power from biomass results in the release of GHG emissions and pollutants into the air. The carbon impact of bioenergy depends on the combustion technology, method of biomass harvesting, re-growing effects, the type of biomass used and the energy source it is displacing. With proper planning and technology selection, it is possible that the biomass DHS can be carbon neutral.

It should be noted that in some cases, "waste wood" (such as slash) is burned as a means of wood disposal. This can result in the unnecessary release of GHG emissions into the air, when the wood could alternatively be burned as a means of heat generation in homes or a bioenergy system.

Additionally, there are other environmental consequences to consider:

- Pollution: Outside of contributing carbon dioxide emissions, burning biomass in a solid, liquid, or gaseous state can also emit other pollutants and particulate matter into the air, including carbon monoxide, volatile organic compounds, and nitrogen oxides.
- Water use: Plants require water to grow; when energy companies grow trees and other crops for a bioenergy plant, they use a lot of water for irrigation. On a large scale, this exacerbates drought conditions, impacting aquatic habitats and the amount of water supply available for other purposes (food crops, drinking, hydropower, etc.).

To minimize potential wood wastes and slash burning in the Upper Skeena region, local communities could explore the option of working with logging contractors to set aside wood was which could be used in homes for wood stove or boilers. This would likely require a policy change to be implemented to allow for waste wood to go to locals rather than being burned as slashed or disposed of in other ways.

BIOMASS OPPORTUNITIES ASSESSMENT

Typically, bioenergy systems are feasible when connected to a cluster of buildings concentrated in one area with a high heating load / demand. Building clusters or areas with a high density of buildings are ideal for bioenergy systems due to:

- Reduced capital costs: Clusters of buildings require shorter primary and secondary piping distribution networks, reducing the capital and construction costs associated with installing the piping network.
- Higher efficiency: An area with a high density of buildings requires shorter piping networks. As the heating fluid travels a shorter distance, the bioenergy system requires less energy and fuel to distribute the heat to all connected buildings.

For a biomass energy project to be feasible for communities within the rural Upper Skeena, the following criteria need to be kept in mind. These include:

- An onsite location with considerable space requirements (1-40 acres), along with a reliable water supply. A network of insulated pipes will have to be constructed to transport hot water from the installation to the buildings using the district heating system.
- A steady, preferably local fuel source. This can be in the form of wood pellets[17], wood chips or logging residue.
- Whether the buildings being supplied with bioenergy require major modifications to accommodate a district energy system
- A closely clustered group of target buildings

If these requirements are met in a financially feasible manner, it might be possible to move on to the next step in a biomass energy project i.e., conducting an environmental concerns assessment to take into account various environmental factors such as deforestation, pollution and water usage.

7

7. BENEFITS OF A REGIONAL ENERGY PLAN

7.1 BENEFITS TO REGIONAL RESIDENTS

The rural Upper Skeena's journey towards a sustainable energy future will result in a plethora of benefits to numerous stakeholders. These include community members and residents, local businesses and extend to the broader country and even globally This subsection will outline the benefits of the transition to regional residents.

A stable power supply will go a long way toward addressing the most highlighted complaint of residents. With a dependable supply of electricity, disruptions to their daily lives from power outages/brownouts will be minimized. This has the obvious benefit of increasing the livability of the region as well as easing the incredible inconvenience and safety issues of not having power. Another very important advantage will be that residents will not be forced to invest in and maintain alternate sources of heating or be forced to deal with the stresses of having to make such arrangements to stay comfortable during inclement weather.

There will be less damage to their property such as appliances blowing out or damage to electrical devices, freeing up residents from costs associated with replacement and repairs. In addition, fridges and freezers can shut down, resulting in spoiled food. This is frustrating not only in homes throughout the region, but also challenging in grocery stores and gas stations which sell perishable food. This challenge will also spill over to any emergency management procedures that the Rural Upper Skeena has in place; having a stable supply of power will improve procedure efficiency and help reduce reliance on backup power.

The shift from diesel generators will also help reduce deleterious health effects of diesel emissions or particulate matter. Diesel particulate matter is carcinogenic and has been linked to a variety of health problems and exposure to it has been deemed a health hazard[18]. Reducing the usage of diesel as an energy source will help residents of Rural Upper Skeena avoid the long-term health impacts of living in community which is exposed to diesel exhaust.

Since one of the core goals of this transition is to enhance the Rural Upper Skeena's energy support network, residents will benefit from increased energy literacy, improved regional awareness regarding their energy use and associated GHG emissions and will be well informed about the impacts of climate change. This increased general literacy will translate into better, more knowledgeable decisions and boost communal buy-in. Knowledgeable community members will accelerate adoption of energy efficiency measures and infrastructure upgrades, which will not only result in decreased energy costs for them but also reduce GHG emissions associated with heating, netting long term benefits for the community at large. This communal education also has the potential to serve as a template for future transitions and plans, perhaps even acting as an example for other neighbouring communities.

The transition will also result in tangible economic benefits for the community. The increased demand for energy efficiency measures, retrofits and infrastructure upgrades will create job opportunities for residents. Local expertise will be required and can be trained for conducting energy evaluations, community awareness, upgrade installation and maintenance. Renewable energy projects will also result in full and part time employment opportunities, both direct (installation, sales, engineering, management) and indirect (administrative, transport/delivery and sales). While some of these positions will be held by those outside the Rural Upper Skeena, many of the positions have the opportunity to be held by residents. If the transition advances as conceptualized, there will be extensive opportunity for SWCC to engage community members in the installation, management and administrative positions associated with renewable energy projects. Residents will also be able to take advantage of various grants, interest free loans and GST/HST new housing incentives. This will serve to not only cut the expenses associated with the installation of clean energy equipment but also accelerate adoption of such technology by lowering the cost barrier.

Other benefits accrue from the Rural Upper Skeena's journey towards and eventually achieving self-reliance by meeting its own energy needs. This will foster a stronger sense of community and empowerment and can possibly act as a way of increasing civic pride. By shifting its energy mix to renewable sources, decreasing the energy intensity of homes, community buildings and infrastructure, the Rural Upper Skeena will reduce its emissions potential, resulting in a variety of benefits such as decreased air pollution, preservation of its natural assets and surrounding ecosystems and ensure long term community livability. These measures will also result in greater alignment with both declared provincial and federal environmental policy.

7.2 BENEFITS TO REGIONAL BUSINESSES

The benefits of the Rural Upper Skeena's energy transition will also extend to regional businesses. Primarily, business will have access to a stable power supply and not have to suffer from power outages/brownouts anymore. A dependable power supply will improve service delivery and reduce the costs associated with businesses having to invest in backup power sources. Costs will be further reduced by the decrease in the amount of maintenance that those backup power sources will need. Essentially, this will cut overhead costs and labour hours that owners and operators can take advantage of to invest back into their respective businesses.

Switching to renewable energy sources will reduce energy bills for businesses and decrease dependency on the commercial power grid. Apart from lower energy bills, there is also an element of financial reassurance associated with having for example, a solar power supply. Being self/semi sufficient on solar power means billing spikes or inflation will have a minimal impact on their costs. Shifting to clean energy equipment also means that businesses will be able to take advantage of tax rebates[19], further increasing their profitability.

7.3 BENEFITS TO CANADA AND THE PLANET

While it might be difficult to conceptualize on a macro scale, there are also benefits that will ensue to Canada as a result of the Rural Upper Skeena's sustainable energy transition. By adopting energy efficiency measures and switching from fossil fuels, the Rural Upper Skeena will contribute less to GHG emissions, a benefit that will play its part in the decrease of national GHG emissions. The shift to renewable energy will also decrease water consumption, an increasingly valuable resource given projected climatic conditions such as hotter and drier summers. These benefits will tie in directly with aiding Canada to be a responsible global citizen, playing its part to reduce GHG emissions and thus combat global climate change.

By decreasing the causes of pollution, which is linked to breathing problems, neurological damage, heart attacks, cancer, premature death, and other health problems, the Rural Upper Skeena will act as a dampener to the strain on Canadian health services. The shift from a fossil fuel heavy energy mix to a renewable one will contribute to national energy reliability and resilience since these will be distributed systems i.e., spread out over a large geographical area and thus minimizing the possibility that a severe weather event in one location will not cut off power to the entire region.

Apart from the advantages mentioned above, research[20] has shown that a regional approach to sustainability avoids certain pitfalls that both macro (top-down approach, led by federal and provincial governments) and micro (locality based) approaches fall prey to. Macro approaches are subject to the whims of political ideologies and often suffer from insufficient knowledge about regional concerns. Micro approaches are criticized because they are said to contribute to sprawl and perpetuate social and economic segregation.

A regional approach towards building resilience and sustainability side steps these criticisms and are generally understood to be more robust and efficient because they operate at a level where there are strong connections between "physical functions, social identity, economic units and political territories"[21]. Their geographical scale tends to be the most efficient one to promote, analyze and evaluate sustainability. As opposed to a fragmented approach towards problem solving, a regional approach can be more effectively promoted by addressing problems and issues that affect the entire region. An approach involving multiple localities should be more efficient since issues like energy resilience tend to span jurisdictional boundaries. Finally, a regional approach can aid the diffusion of federal and provincial policies since regional initiatives to implement those policies can increase buy-in by creating both awareness and motivation amongst regional members.

The switch from fossil fuels will also reduce demand for the same which will be the Rural Upper Skeena's contribution towards reducing Canadian dependency on foreign oil imports, consequently improving Canadian self-sufficiency and energy resilience.


8

8. NEXT STEPS & ADDITIONAL RESOURCES

This section will summarize the findings of the report, identify and list funding opportunities to support renewable energy projects and retrofits and outline how to set the stage for further dialogue with BC Hydro.

8.1 A SUSTAINABLE ENERGY FUTURE

The Empowered Energy Solutions main project objective was to build energy literacy in the region and develop an understanding of the current energy issues in the region. With these findings, SWCC and team have highlighted solutions to move forward with both saving energy through conservation methods and highlighting suitable renewable energy technologies for the region to address energy security.

The SWCC – Urban Systems team has established a series of suggested next steps and recommendations to help build a succession plan to see this project and plan move forward. To support the continued advancement of the next steps described below, it is suggested that a project "champion" from the region take a leadership role in continuing to advance project implementation efforts.

This project champion could potentially lead the development of a regional "working group", which could be comprised of residents, community members, and community staff from the study area who collaboratively work to advance various community engagement and project implementation efforts.

Through the Regional Energy plan and the StoryMap web platform developed for this project, the region will have tools to increase energy literacy and participate and collaborate in discussions on how to move forward with building a secure and sustainable energy future.

As such, proposed next steps would include the following:

NEXT STEPS

- **Identification of a project "champion" or leader from the region to continue to advance project engagement and implementation efforts**
- **Development of a regional "working group" comprised of residents, community members, and (where appropriate) community staff. This working group could provide suggestions on future community engagement efforts, share information with others on their energy-related initiatives, and support other residents or communities of the region in implementing their own projects.**
- **Community engagement sessions to discuss the outcomes of the Empowered Energy Solutions project**
- **Community capacity building and engagement sessions presenting on renewable energy technologies which may be suitable in the region**
- **Community capacity building and engagement sessions discussing residential energy conservation methods**
- **Develop surveys to get an understanding of where the region wants to go with building a more secure and sustainable energy future**
- **Work with all levels of government, including leadership of local First Nations communities, to identify opportunities for collaboratively advancing various projects which would support the region in achieving energy goals**

In addition, it will be important to begin building a working relationship with BC Hydro to discuss the region's Energy Plan, energy challenges in the region, and the region's "energy vision" moving forward to determine where collaboration is possible.

8.2 POTENTIAL FUNDING OPPORTUNITIES

The following tables summarize various renewable energy, demand side management and capacity building, and building retrofit funding opportunities which may be of interest to SWCC, communities and residents of the Rural Upper Skeena.

Table 8-1: Renewable Energy Funding Opportunities

Funding Program	Program Summary	Funding Available	Program Link
First Nations Clean Energy Business Fund	Funding is available for applicants to develop a feasibility study of potential clean energy projects. Funding can also be used to develop a business plan related to the development of a renewable energy project or renewable energy company.	$50,000 per applicant	https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations-clean-energy-business-fund https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first-nations/agreements/fncebf_guidelines.pdf
BC Indigenous Clean Energy Initiative	Funding is available for clean energy feasibility and site selection, project design and engineering or the installation of clean energy projects.	N/A	https://www.newrelationshiptrust.ca/initiatives/bcicei/
Community Energy Diesel Reduction (CEDR) Program	Under the Renewable Energy Generation (REG) funding stream, CEDR provides stage-gated support for renewable electricity generation, which provides funding at the applicable stage of project development.	N/A	https://www.newrelationshiptrust.ca/funding/community-energy-diesel-reduction-cedr-program/
Indigenous Community Infrastructure Initiative (ICII)	Canadian Infrastructure Bank will provide loans for the development of clean power projects. Requires community contribution	Minimum $5 million, up to $50 million, up to 80% of project capital cost.	https://cib-bic.ca/en/sectors/indigenous-infra/
Clean Energy in Indigenous, Rural and Remote Communities Program	Using a continuous intake process, these programs provide funding for the research, development, demonstration, and deployment of renewable energy, bio-heating, and capacity building projects to transition remote and Indigenous communities off diesel. The programs will fund projects in all stages of development and is open to supporting all technologies.	Range of funding available per project: Up to $100,000 From $100,000, to $1,000,000, over $1,000,000	https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/reduce-emissions/reducing-reliance-diesel.html

Table 8-2: Demand Side Management and Capacity Building Funding Opportunities

Funding Program	Program Summary	Funding Available	Program Link
First Nations Clean Energy Business Fund	Funding is available for applicants to develop and implement demand-side management projects / programs.	$150,000 per applicant	https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations-clean-energy-business-fund https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first-nations/agreements/fncebf_guidelines.pdf
BC Indigenous Clean Energy Initiative	Funding is available for applicants to develop and implement demand-side management projects / programs.	N/A	https://www.newrelationshiptrust.ca/initiatives/bcicei/
Business Energy Savings Incentive Program (Commercial)	Business Energy Saving Incentives is a self serve online program offering which calculates incentives based on actual hours of use, energy savings per project and payback time using a tiered incentive structure.	Up to $100,000, up to 75% of project costs, up to 75% of incentive funding for project	https://www.bchydro.com/powersmart/business/programs/business-incentives.html
CleanBC Communities Fund	Funding is available for applicants who wish to develop renewable energy projects, increase access to clean energy transportation (EV charging stations), or increase building energy efficiency.	Unlimited, dependent on applicable project costs.	https://www2.gov.bc.ca/gov/content/transportation/funding-engagement-permits/funding-grants/investing-in-canada-infrastructure-program/green-infrastructure/cleanbc-communities-fund https://www2.gov.bc.ca/assets/gov/driving-and-transportation/funding-engagement-permits/grants-funding/investing-in-canada/icip-clean-communities-fund-program-guide.pdf

Table 8-3: Building Retrofit Funding Opportunities

Funding Program	Program Summary	Funding Available	Program Link
Community Energy Diesel Reduction (CEDR) Program	Provides non-repayable funding contributions for clean energy initiatives to eligible remote communities that are off-grid and rely on diesel fuel for electricity generation Three funding streams: community energy planning, demand side management, renewable energy generation.	Up to $1000 for energy assessments and cost estimate development Up to $5500 for envelope measures like attic insulation, air sealing, basement insulation. Up to $16,000 for heat pumps Up to $3000 for retrofit enabling	https://www.newrelationshiptrust.ca/funding/community-energy-diesel-reduction-cedr-program/ https://www.newrelationshiptrust.ca/wp-content/uploads/2022/08/CEDR-DSM-Incentive-Amounts.pdf
BC Hydro Indigenous Communities Conservation Program – Home Energy Check-up	Bands are eligible for free energy-saving products to assist with home energy upgrades for community members. This program offers salary support for Bands to hire members or local contractors to assist with product installations.	Free products available, including LED lighting, faucet aerators, door sweeps, draft proofing tape, dryer racks, etc. Salary supports available for Band members / local contractors to assist with installation.	https://www.bchydro.com/powersmart/local_government_district/indigenous-community-offers.html https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/residential/programs/indigenous-communities-conservation-program-product-install-guide.pdf#page=6
BC Hydro Indigenous Communities Conservation Program – Home Energy Upgrade Rebates (Stream 2 – Major Retrofits)	Eligible upgrades include those to the building envelope, ventilation, equipment and appliances. These rebates are only for electrically heated homes.	Funding available for insulation and draft proofing, ENERGY STAR windows, doors, refrigerators (manufactured in 2002 or earlier), freezers, ASHPs, electric heat pump water heaters (once space/water heaters are electrified, the full suite of rebates under ICCP will become available).	www.bchydro.com/iccp
Clean BC Heat Pump Incentive for Indigenous Communities	Covers capital and installation costs.	Up to 80% of the cost of new heat pump installations.	https://betterhomesbc.ca/rebates/icec-offer/
Green and Inclusive Community Buildings	Offers funding to construct new, efficiency community buildings or complete significant retrofits to existing buildings.	Up to $3,000,000 per building.	https://www.infrastructure.gc.ca/gicb-bcvi/index-eng.html#2
NRCan Greener Homes Initiative	Provides grants and a loan for home evaluations and for retrofits. Eligible retrofits include home insulation, windows and doors, air sealing, and mechanical and renewable energy systems.	Up to $5000 for home insulation Up to $1300 for air sealing Up to $325 per window or door Up to $5000 for space and water heating Up to $1300/kW for renewable energy Up to $1300 for resiliency measures	https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/start-your-energy-efficient-retrofits/all-about-the-canada-greener-homes-initiative/23476 https://www.nrcan.gc.ca/sites/nrcan/files/energy/efficiency/Greener%20Homes%20Grant%20Form%20Indigenous%20-%20EN-rr.pdf
Community Buildings Retrofit (CBR)	The Green Municipal Fund's (GMF) Community Buildings Retrofit (CBR) initiative supports local governments and not-for-profit organizations in retrofitting public buildings to improve energy performance, lower operating and maintenance costs, and transition to cleaner energy solutions over time.	Type of funding: loan or grant Range of funding available per project: Up to $100,000 From $100,000, to $1,000,000, over $1,000,000	https://greenmunicipalfund.ca/ https://greenmunicipalfund.ca/community-buildings-retrofit-initiative

8.3 NETWORK BUILDING FOR LOCAL SERVICES

Table 10-4 below summarizes a variety of local companies and services which were utilized throughout the course of this project, or could be used in future project implementation efforts.

Table 10-4: Local Services to Support Energy-Related Projects

LICENSED ENERGY ADVISORS *(through Natural Resources Canada)*

Name of Company	Contact Information
Bulkley Skeena Energy Solutions Smithers, BC • Whole home energy evaluation services • Licensed Energy Advisor through Natural Resources Canada • Infrared thermography • Blower door air leakage testing • New home energy modeling	Miguel Chenier, Energy Advisor PH: (250) 917-9238 Email: bulkleyskeena@gmail.com www.bulkleyskeenaenergysolutions.ca
Bent Box Energy Solutions Smithers BC • Whole home energy evaluation services • Licensed Energy Advisor through Natural Resources Canada • Infrared thermography • Blower door air leakage testing	Richard Joseph, Energy Advisor PH: (250) 877-1974 Email: richardjoseph1962@gmail.com

ENERGY CONSULTANTS

Name of Company	Contact Information
Harbour Renewables Ltd Hazelton, BC • Feasibility Studies for Renewable Energy Projects	Tim Butement PH: (250) 842-3061 Email: timb@harbourrenewables.ca www.harbourrenewables.ca

SOLAR ENERGY

Name of Company	Contact Information
Harbour Renewables Ltd Hazelton, BC	Tim Butement PH: 250-842-3061 Email: timb@harbourrenewables.ca www.harbourrenewables.ca
Energy Alternatives Ltd. Smithers, BC	Kevin Pegg PH: (250) 846-9888 Email: sales@energyalternatives.ca www.energyalternatives.ca
Egenolf Alternative Energy Inc. Smithers, BC • Solar and biomass energy solutions	John Egenolf PH: (250) 900-0156 Email: egenolf.bc@gmail.com www. bvsolar.ca

HEATING & PLUMBING

Name of Company	Contact Information
Aqua North Plumbing and Heating Smithers, BC • Heat Pumps – Boiler systems	2909 19 Ave, Smithers, BC V0J 2N0 Areas served: Smithers and nearby area PH: (250) 847-3858 www.aquanorth.ca
Copper River Heating and Plumbing Smithers, BC	3176 Tatlow Rd, Smithers, BC V0J 2N0 Areas served: Hazelton and nearby areas PH: (250) 847-0046
North Central Plumbing and Heating Smithers, BC	3352 BC-16, Smithers, BC V0J 2N0 Areas served: British Columbia PH: (250) 847-3060 www.nch.ca
Herman Svab Heating, Plumbing and Gas Smithers, BC	4145 3 Ave, Smithers, BC V0J 2N3 PH: (250) 847-1550
Andrew Sheret Ltd • Plumbing Supply	Wholesale Counter 4650 Keith Ave, Terrace, BC V8G 4K1 PH: (250) 638-8840 www.sheret.com

APPENDIX A - Energy Audit Results for Log Home

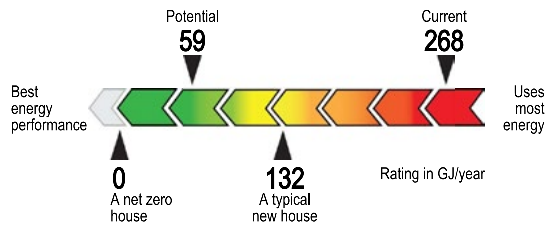
File Number: 34C2D00167

RENOVATION UPGRADE REPORT

ENERGUIDE

430 Salmon River Rd
Hazelton, BC V0J 1Y5

Year built: 1978



Assessment date:	**Evaluated by:**	**Quality assured by:**
September 21, 2022	Miguel Chenier 250-917-9238	Verdatech 403-251-0683 223

This report identifies your home's energy savings opportunities by providing you with recommended renovation upgrades. It complements your EnerGuide label and your homeowner information sheet.

Next steps:

- Review your customized action plan below to improve the energy efficiency of your home;
- You may be eligible for **financial incentives** to support your energy-efficient upgrades. Please visit *www.canada.ca/greener-homes-grant* to view the financial incentives available.
- Need help getting started? Go to our **resources** *www.nrcan.gc.ca/kthi.*

YOUR ENERGY EFFICIENCY ROADMAP

Your energy advisor has prioritized your recommended upgrades based on the potential energy savings, the life expectancy of your home components, the interactions between systems, your potential renovation plans and the costs to perform the upgrades.

1. **Perform air sealing** [Save 20 GJ/year]
2. **Upgrade doors** [Save 4 GJ/year]
3. **Insulate attic** [Save 14 GJ/year]
4. **Insulate foundation** [Save 46 GJ/year]

Additional recommendations on next pages

By implementing all upgrades, you are helping to fight climate change and could **reduce GHG emissions by up to 5.6 tonnes per year.**

Renovation Upgrade Report | Page 1 of 12 | Report date: October 11, 2022

RECOMMENDED ENERGY EFFICIENCY UPGRADES

A customized plan to improve the energy efficiency of your home is found below:

1. Perform air sealing

- ❑ **Improve the airtightness of your house by 23% to achieve 9.54 air change(s) per hour at 50 pascals.**

This upgrade could reduce the energy consumption of your house by 20 gigajoules per year.

Did you know?
Air leakage accounts for 31 percent of the estimated annual heat loss of your house.

Useful tips

Air sealing is one of the most cost-effective energy-saving measures you can undertake. It is typically performed before and during other upgrades to ensure optimal benefit. Air sealing can help to minimize potential moisture damage and improve comfort by reducing drafts, heat loss, dust and outdoor noise in your home.

Consult our **resources** *www.nrcan.gc.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/keeping-the-heat/15768* to learn more and take action.

Air leakage locations identified by your energy advisor are listed below:

- ❑ Greener Homes Grant: Air Sealing Air Sealing - Greener Homes Grant Through the Canada Greener Homes Grant initiative, a grant between $550 and $1000 is available for improving the airtightness of your home based on the level achieved. This is one of the most cost-effective energy-saving measures you can undertake. An air-sealing grant is available if the airtightness of your home is improved to achieve or exceed the air change rate target proposed above. Achieving any of the targets defined for your home typically requires that the work be performed by an air-sealing professional.

2. Upgrade doors

- ❑ **Replace one door with an ENERGY STAR certified model.**

This upgrade could reduce the energy consumption of your house by 4 gigajoules per year.

Did you know?
Doors account for 2 percent of the estimated annual heat loss of your house.

Useful tips

ENERGY STAR certified doors are among the most energy efficient in the marketplace. If there is a window in the door, consider units with low-E coatings and inert gas fills.

Consult our **resources** *www.nrcan.gc.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/keeping-the-heat/15768* to learn more and take action.

Your energy advisor's comments

Greener Homes Grant: Doors Through the Canada Greener Homes Grant initiative, a grant of $125 per hinged door system is available when an eligible ENERGY STAR certified door or door system is installed. Replacing old, damaged or leaky hinged doors with new ENERGY STAR certified products can help you save on energy and improve comfort. To determine eligibility of the product you are seeking to purchase, confirm that it is included on the list of eligible equipment as found on the Canada Greener Homes Grant webpage.

RECOMMENDED ENERGY EFFICIENCY UPGRADES - CONTINUED

3. Insulate attic

- ❑ **Increase the insulation value of your attic (Ceiling (Sides)) by RSI 6.70 (R-38.1).**
- ❑ **Increase the insulation value of your attic (Ceiling (Upper)) by RSI 5.49 (R-31.2).**

This upgrade could reduce the energy consumption of your house by 14 gigajoules per year.

Did you know?

Ceilings account for 7 percent of the estimated annual heat loss of your house.

Useful tips

The following are some of the items to consider before insulating the attic:

- ❑ Ensure the roof does not leak.
- ❑ Ensure electrical work is up-to-date and that all desired ceiling fixtures have been installed.
- ❑ Look for opportunities to air seal before insulation is added.
- ❑ Ensure adequate attic venting is installed and that it is not blocked by insulation.
- ❑ Ensure all exhaust fans and ducts penetrating the attic are sealed and vented to the outside.

Consult our **resources** *www.nrcan.gc.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/keeping-the-heat/15768* to learn more and take action.

Your energy advisor's comments

Greener Homes Grant: Attic Insulation Ceilings - Greener Homes Grant (vented attics) The Canada Greener Homes Grant offers grants of up to $1,800 for increasing home insulation in attics, cathedral ceilings and flat roofs. The amount you are eligible for will depend on factors such as what insulation is currently in your home, how much insulation you add and type of attic/ceiling your home has. Insulation slows the rate of heat loss, resulting in improved energy use and can help save money. Installing insulation in an attic, cathedral ceiling or flat roof is eligible for a grant, as long as minimum levels of insulation and coverage are achieved. If your house consists of more than one roof or roof type, the grant amount will be pro-rated or calculated based on roof type and area. Should you have vented attics, then the insulation value in was assessed at (please see your Homeowner Information Sheet page 2 – this page details what your existing insulation levels are and must be taken into consideration when determining the available grant). Based on this value, the amount of grant that you could obtain would be as follows: - should it be at or less than R-12, a grant of up to $1800 is available through the Canada Greener Homes Grant initiative for adding insulation to reach R-50 or more. - If greater than R-12 but less than or equal to R-25, a grant of up to $600 is available through the Canada Greener Homes Grant initiative for adding insulation to reach R-50 or more. - If greater than R-25 but less than or equal to R-35, a grant of up to $250 is available through the Canada Greener Homes Grant initiative for adding insulation to reach R-50 or more Roofing Membrane Through the Canada Greener Homes Grant, a grant of $150 is available for installing a self-adhering roofing underlayment applied to the entire roof surface. This resiliency measure must be combined with an energy efficiency retrofit from the Canada Greener Homes Grant to be eligible.

4. Insulate foundation

- ❑ **Increase the insulation value of 100% of your basement walls (Basement) from the interior by RSI 3.33 (R-18.9).**
- ❑ **Increase the insulation value of your foundation headers (BW hdr-01) by RSI 3.34 (R-19.0).**

RECOMMENDED ENERGY EFFICIENCY UPGRADES - CONTINUED

This upgrade could reduce the energy consumption of your house by 46 gigajoules per year.

Did you know?

Your foundation accounts for 30 percent of the estimated annual heat loss of your house.

Useful tips

Assess the status of your foundation for water leaks, cracks and flooding and remediate these issues before beginning any insulation job. Foundations can be insulated from the interior, exterior or a combination of both depending on accessibility and the complexity of the building. Refer to your energy advisor's comments to determine which would be best suited for your foundation.

Consult our **resources** *www.nrcan.gc.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/keeping-the-heat/15768* to learn more and take action.

Your energy advisor's comments

Greener Homes Grant Foundations Foundations - Greener Homes Grant Basement Wall Insulation The Canada Greener Homes Grant initiative offers grants of up to $1500 for adding insulation to basement walls. Insulating basement walls can reduce energy costs and improve comfort. Grants are based on the RSI/R-value of the added insulation and the percentage of wall area insulated. The current amount of insulation does not affect the grant amounts. A minimum of 20% of the exterior basement wall area must be insulated. Basement Header Insulation Through the Canada Greener Homes Grant initiative, a grant of $240 is available for adding insulation to basement headers. In an unfinished basement, sealing and insulating headers can be a relatively simple task. The grant of $240 is available when RSI 3.52 (R-20) is added to the entire header area along with air sealing. The grant is still available if only 80% can be insulated and air sealed. Basement Slab Insulation Through the Canada Greener Homes Grant initiative, a grant of $400 is available for adding insulation to your basement slab. Adding board insulation on top of the slab can significantly improve the comfort of a basement area. The grant of $400 is available when RSI 0.62 (R-3.5) is added to at least 50% of the slab. Crawl Space Wall and Header Insulation Through the Canada Greener Homes Grant initiative, a grant of up to $1300 is available for adding more than RSI 3.87 (R-22) insulation to crawl space exterior walls and headers. Insulating crawl space walls and headers can reduce energy costs and improve comfort in the occupied space above the crawl space. The grant is available if insulation is added to all exterior crawl space walls and headers. A grant is available for adding a minimum of RSI 1.76 (R-10) insulation. Crawl Space Ceiling Insulation Through the Canada Greener Homes Grant initiative, a grant of up to $800 is available for adding insulation to 100% of the crawl space ceilings. Insulating your crawl space ceiling can reduce heating needs and do much to improve comfort in the living quarters above. The grant is available if more than RSI 4.23 (R-24) insulation is added to the entire ceiling. Foundation Waterproofing Through the Canada Greener Homes Grant, a grant of $875 is available for waterproofing exterior foundation walls. This resiliency measure must be combined with an energy efficiency retrofit from the Canada Greener Homes Grant to be eligible. Crawl Space Waterproofing Through the Canada Greener Homes Grant, a grant of $600 is available for moisture proofing 100% of the crawl space floor, walls, and headers. This resiliency measure must be combined with an energy efficiency retrofit from the Canada Greener Homes Grant to be eligible.

5. Upgrade windows

- ❑ **Replace 11 windows with ENERGY STAR certified models.**

This upgrade could reduce the energy consumption of your house by 7 gigajoules per year.

Did you know?

Windows account for 10 percent of the estimated annual heat loss of your house.

Useful tips

RECOMMENDED ENERGY EFFICIENCY UPGRADES - CONTINUED

Replacing windows can improve aesthetics, reduce noise from outside, reduce maintenance, increase property resale value, improve comfort and reduce condensation during cold weather. ENERGY STAR certified windows, patio doors and skylights are among the most energy efficient in the marketplace.

Consult our **resources** *www.nrcan.gc.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/keeping-the-heat/15768* to learn more and take action.

Your energy advisor's comments

Greener Homes Grant: Windows Through the Canada Greener Homes Grant initiative, grants of either $125 or $250 per window rough opening are available when an ENERGY STAR certified or ENERGY STAR certified Most Efficient window is installed to replace an existing window. Replacing old, damaged or leaky windows with new ENERGY STAR certified products can help you save on energy, improve comfort and reduce noise. To determine eligibility of the product you are seeking to purchase, confirm that it is included on the list of eligible equipment as found on the Canada Greener Homes Grant webpage.

6. Insulate main walls

- **Increase the insulation value of your main walls (Second level (Sides)) by RSI 1.41 (R-8.0).**
- **Increase the insulation value of your main walls (Second level (Ends)) by RSI 1.41 (R-8.0).**

This upgrade could reduce the energy consumption of your house by 20 gigajoules per year.

Did you know?

Main walls account for 19 percent of the estimated annual heat loss of your house.

Useful tips

Main walls can be insulated from the interior, exterior or both using a variety of materials and methods. Refer to your energy advisor's comments to determine the best approach.

Consult our **resources** *www.nrcan.gc.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/keeping-the-heat/15768* to learn more and take action.

Your energy advisor's comments

Greener Homes Grant: Exterior Wall Insulation Main Wall Insulation - Greener Homes Grant Through the Canada Greener Homes Grant initiative, a grant of up to $5,000 is available for adding insulation to exterior wall area of your home. Insulation grants are based on the percentage of wall area to which the insulation has been added and the amount of insulation added. A minimum of 20% of the exterior wall area of your home, excluding foundation walls, must be insulated in order to qualify for a grant.

7. Upgrade heating system

- **Install a new ENERGY STAR certified air-source heat pump that has a heating seasonal performance factor (HSPF) of 10.**

This upgrade could reduce the energy consumption of your house by 159 gigajoules per year.

Did you know?

Space heating accounts for 84 percent of the estimated annual energy use of your house.

RECOMMENDED ENERGY EFFICIENCY UPGRADES - CONTINUED

Useful tips

Perform any planned building envelope upgrades before your heating contractor begins work since a more energy efficient building envelope may mean that a smaller heating system could be installed. The contractor should first conduct a heat loss calculation before deciding on the capacity and model of your heating system.

Your *Homeowner Information Sheet* provides important details and a reference for this calculation. Inform your heating contractor of any building envelope upgrades performed since your evaluation, or that will be undertaken since these may render certain details in your *Homeowner Information Sheet* inaccurate.

Consider purchasing a system that is ENERGY STAR certified when available. Consult Natural Resources Canada's website at *www.nrcan.gc.ca/energy/products/categories/heating/13740* for information on choosing a heating system.

Your energy advisor's comments

Greener Homes Grant Heating System Heating System Replacing Existing Heating Systems (Heat Pump) It is important to note that only heat pumps (ground source and air source) are included in the grant and furnaces are not included. For certain areas of Canada, such as Alberta and Saskatchewan, a furnace may still be the most appropriate upgrade and we strongly recommend that you fully investigate your options to ensure that you are installing the right technology for your climatic region and area within Canada. Whole System Replacement – Ground/Water Source Through the Canada Greener Homes Grant initiative, a grant of $5000 is available for installing a new earth-energy (ground or water source) heat pump – full system. An earth-energy (ground or water source) system will reduce heating and cooling costs, but is not always feasible depending on the region in which you live other considerations. Consult with a professional in this field to determine if this type of system is practical for the region in which you live. To determine eligibility of the product you are seeking to purchase, confirm that it is included on the list of eligible equipment as found on the Canada Greener Homes Grant webpage. Heat Pump Only – Ground/Water Source Through the Canada Greener Homes Grant initiative, a grant of $3000 is available for replacing the heat pump of an existing earth-energy (ground or water source) system. To determine eligibility of the product you are seeking to purchase, confirm that it is included on the list of eligible equipment as found on the Canada Greener Homes Grant webpage. Air Source Heat Pump (ASHP) and Cold Climate ASHP (ccASHP) Through the Canada Greener Homes Grant initiative, a grant of $2500 is available for smaller Air Source Heat Pumps (ASHP) or cold climate Air Source Heat Pumps (ccASHP). $4000 is available for larger ASHPs and $5000 for large ccASHPs, depending upon the type installed. Speak with an HVAC professional for recommendations on the type of heat pump that is best suited for your home, for example, an air-source heat pump, or if you live in a colder climate, a cold-climate heat pump. Depending upon the region in which you live and how you heat your home today, the installation of a heat pump in your home may result in higher utility costs. Consult with an HVAC professional in this field to determine if this type of system is practical and the right choice for your circumstances. To determine eligibility of the product you are seeking to purchase, confirm that it is included on the list of eligible equipment as found on the Canada Greener Homes Grant webpage. The heating load of your home is (see page 2 of your Homeowner Information Sheet. It is important to note that this value is based on the current home and does not include any upgrades. If sizing the system and other upgrades are expected to be completed, it is imperative that these upgrades that these upgrades are also taken into consideration. A CSA F280 calculation must be completed by your heating contractor to confirm the size of your required mechanical system. It is their responsibility to ensure your heating system is of the correct size). Your new heat pump must be sized to supply heat to your entire home. Ask the professional to size your heat pump according to the heating load of your entire home as indicated above. For more information: Natural Resources Canada has developed a package of materials related to air source heat pump sizing and selection, intended for use by mechanical system designers and renovation contractors. https://www.nrcan.gc.ca/maps-tools-and-publications/tools/modelling-tools/toolkit-for-air-source-heat-pump-sizing-and-selection/23558 Smart Thermostat Rebate (Greener Homes Grant) Under the Canada Greener Homes Grant initiative, a grant of $50 is available for replacing one manual thermostat by a programmable or smart/adaptive thermostat.

8. Upgrade cooling system

- Install a new ENERGY STAR certified air conditioner.

RECOMMENDED ENERGY EFFICIENCY UPGRADES - CONTINUED

This upgrade could increase the energy consumption of your house by 1 gigajoules per year.

Did you know?

Space cooling accounts for 0 percent of the estimated annual energy use of your house.

Useful tips

Perform any planned building envelope upgrades before your contractor begins work since a more energy efficient building envelope may mean that a smaller cooling system could be installed. The contractor should first conduct a heat gain calculation before deciding on the capacity and model of your cooling system.

Your *Homeowner Information Sheet* provides important details and a reference for this calculation. Inform your contractor of any building envelope upgrades performed since your evaluation, or that will be undertaken, since these may render certain details in your *Homeowner Information Sheet* inaccurate.

Consider purchasing a system that is ENERGY STAR certified. Consult Natural Resources Canada's web site at *www.nrcan.gc.ca/energy/products/categories/cooling-ventilating/13756* for more information.

Your energy advisor's comments

9. Add a renewable energy system

❑ **Install a photovoltaic system designed to deliver 5847.7 kilowatt-hours per year.**

This upgrade could reduce the energy consumption of your house by 24 gigajoules per year.

Did you know?

Solar and wind energy can be used for electricity generation.

Useful tips

Installing renewable energy systems will offset some or potentially all of the purchased energy required to operate your home while decreasing the greenhouse gas emissions generated.

Your energy advisor's comments

Greener Homes Grant Solar PV Renewables – Greener Homes Grant Residential (Solar PV Rebate) Through the Canada Greener Homes Grant initiative, a grant of $1,000 per KW is available for installing a photovoltaic solar panel. If you choose to install a photovoltaic (PV) system, it is strongly recommended that a full assessment by a professional solar photovoltaic installer, including the measuring of solar irradiance (how much sunlight falls on the roof) is undertaken to provide detailed information on considerations for your home and specific installation recommendations, including the size and related energy production of the system. The rated PV panel must have peak power capacity higher than or equal to 1.0 kW. The system must be composed of photovoltaic (PV) panel and inverter certified to CSA Standards. Solar Photovoltaic Battery Storage Through the Canada Greener Homes Grant initiative, a grant of $1000 is available for the installation of battery storage and an inverter to connect to a photovoltaic system to provide standby power for the home for an existing PV system or a new install. This resiliency measure must be combined with an energy efficiency retrofit from the Canada Greener Homes Grant in order to be eligible. This grant may be combined with the new PV installation grant for a maximum grant of $5000.

RECOMMENDED ENERGY EFFICIENCY UPGRADES - CONTINUED

Additional energy advisor comments

Greener Homes Grant Program Through the Canada Greener Homes Grant, homeowners are eligible for up to $600 for the cost of pre- and post-retrofit EnerGuide evaluations and up to $5,000 total for the implementation of eligible retrofits completed after December 1, 2020. Hiring a contractor is the recommended option in undertaking several of the home retrofits and for some retrofits it is a requirement. The contractor is responsible for complying with local bylaws and relevant provincial, territorial and federal legislation and guidelines. ELIGIBILITY INFORMATION For full details on eligibility requirements, eligible measures and grants for the recommended measures outlined below, please consult the Canada Greener Homes Grant website at canada.ca/greener-homes-grant or your Homeowner Information Kit. Many eligible retrofit measures under the Canada Greener Homes Grant have certain conditions for eligibility. These include: 1. In order to be eligible for reimbursement for your retrofit, you must complete at least one retrofit that is both eligible and recommended by an energy advisor in this Renovation Upgrade Report. 2. If you wish to undertake resiliency measures or purchase a thermostat, you must also undertake another eligible energy efficiency measure in order to qualify for a grant. 3. Purchased equipment such as heat pumps and windows must meet eligibility criteria and must be on the eligible product list as found on the Canada Greener Homes Grant website. This information can also be found in the Homeowner Information Kit. 4. All mechanical and electrical systems, with the exception of thermostats, must be installed by a licensed and trained professional. It is highly recommended that you use the attestation forms found on the Canada Greener Homes Grant website and Canada Greener Homes Grant Portal (if applicable for your retrofit) confirming that: o installation of an electrical or mechanical system has been completed by a trained and licensed professional* o an earth-energy (ground or water) system was installed in accordance with CSA standards o the heat pump has been sized to your entire home *When using a licensed professional it is highly recommended that you obtain proof of their licence to install equipment in your province or territory. 5. All products must be purchased in Canada. Online purchases are only eligible if they are ordered from an online distributor located in Canada. ADDITIONAL OPPORTUNITIES FOR INCENTIVES You may access and combine grant funding from the Canada Greener Homes Grant with funding from other retrofit grant programs in your region. The sum of the funding you receive from all sources must not exceed 100% of the total cost of the pre- and post-retrofit EnerGuide evaluations and of each eligible retrofit measure. Participants will be required to declare through the Canada Greener Homes Grant Portal funding or rebates received from other sources.

NOTES:

- Energy use reductions are calculated with each upgrade taken on its own. Combinations of upgrades may produce slightly different results.
- If negative savings are shown, please see your energy advisor's comments for an explanation.

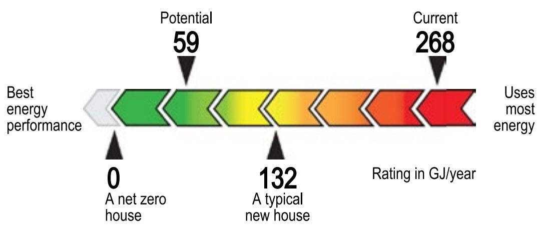
ENERGY EFFICIENCY FORECAST

YOUR HOME'S ENERGY POTENTIAL

By implementing the recommended upgrades, you will not only see an improvement in your EnerGuide Rating but you might also reduce greenhouse gas (GHG) emissions.

Note that the energy consumption indicated on your utility bills may be higher or lower than your EnerGuide Rating. This is because the EnerGuide Rating is based on standard assumptions regarding how many people live in the home and how it is operated. Refer to your *Homeowner Information Sheet* for details on the EnerGuide Rating System standard operating conditions.

EnerGuide Rating



A **gigajoule (GJ)** is a unit of energy that can represent all energy sources found in Canadian homes such as electricity, fossil fuels and wood.

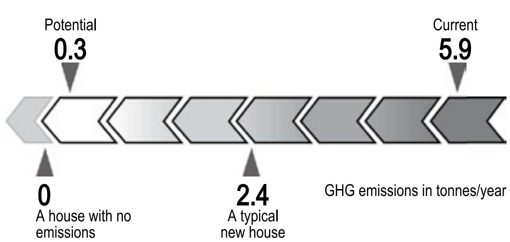
A **typical new house** is a reference point for comparing your rating to that of a similar house built to current energy efficiency requirements.

Rated energy intensity

Potential: 0.37 GJ/m²/year | **Current :** 1.25 GJ/m²/year

The **Rated energy intensity** is an estimate of your home's annual energy use relative to its size. It allows you to compare the energy used by homes of different sizes on a "per square metre" basis.

Rated greenhouse gas (GHG) emissions

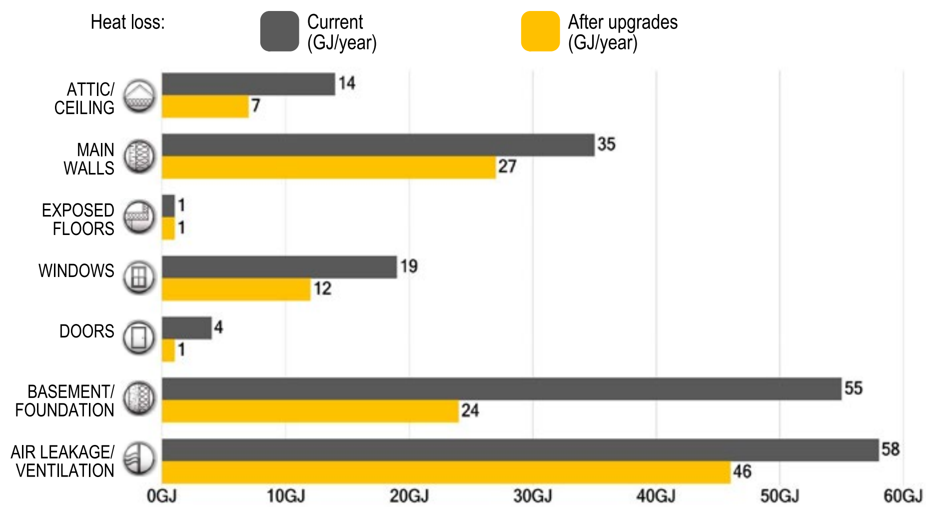


Every time we use energy from fossil fuels such as oil and gas, we produce **greenhouse gas (GHG) emissions** that contribute to climate change. We can reduce these emissions by making homes more energy efficient and lowering energy use.

ENERGY EFFICIENCY FORECAST - CONTINUED

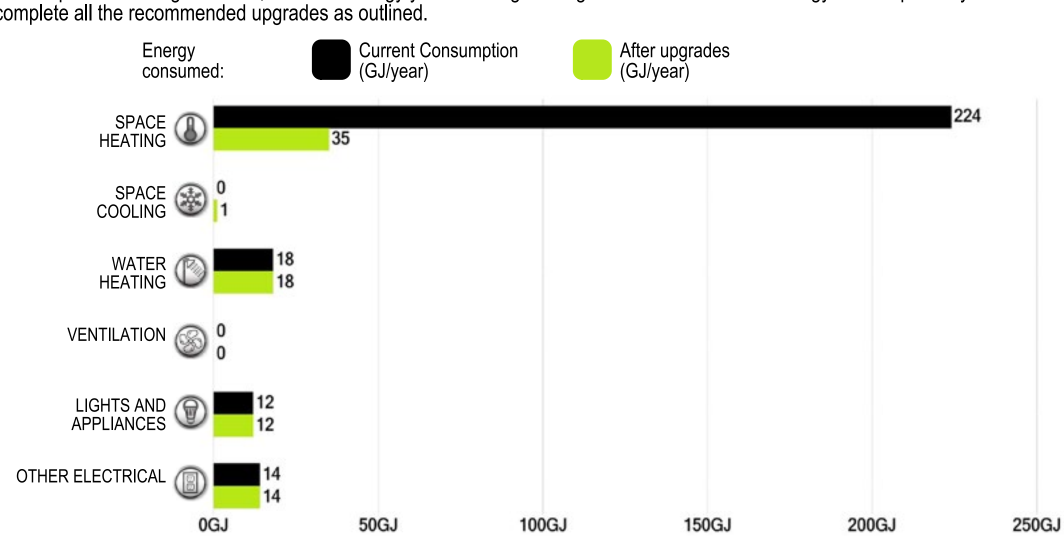
BEFORE AND AFTER: Estimated heat loss through the building envelope*

This bar chart shows where heat is lost from your house. The dark bars show the areas where you are currently losing heat. The longer the bar, the more heat you are losing. The light bars show the estimated heat loss if you were to complete all the recommended upgrades as outlined.



BEFORE AND AFTER: Estimated energy use*

This bar chart shows the potential for improving the energy performance of your house. The dark bars show your current rated consumption. The longer the bar, the more energy you are using. The light bars show the rated energy consumption if you were to complete all the recommended upgrades as outlined.



*Calculated using standard operating conditions. Refer to your *Homeowner Information Sheet* for more information.

Renovation Upgrade Report | Page 10 of 12 | Report date: October 11, 2022

ADDITIONAL INFORMATION

HEALTH AND SAFETY INFORMATION

If your energy advisor has identified a potential health or safety concern related to insufficient outdoor air, risk of combustion fumes being drawn into the home or the presence of vermiculite, a warning has been included in your *Homeowner Information Sheet*. However, energy advisors are not required to have expertise in health and safety matters, and it is the sole responsibility of the homeowner to consult a qualified professional to determine potential hazards before undertaking any upgrades or renovations. Visit Natural Resources Canada's webpage *Health and safety considerations for energy-efficient renovations.*

Humidity control

A relative humidity level of between 30 and 55 percent is recommended for optimal health and comfort. For more information on assessing moisture levels in your house, visit the Canada Mortgage and Housing Corporation's website.

Radon

Radon is a naturally occurring radioactive gas that is colourless, odourless and tasteless. It is formed from the radioactive decay of uranium, a natural material found in some soil, rock and groundwater. When radon is released into the outdoor air, it gets diluted to low concentrations and is not a concern. However, in enclosed spaces like houses, it can sometimes accumulate to high levels, which can pose a risk to both your or your family's health. For more information, visit Health Canada's website.

Asbestos and vermiculite insulation

Vermiculite insulation installed in homes may contain asbestos. This can cause health risks if inhaled. If you find vermiculite insulation during renovations, avoid disturbing it. If you suspect the presence of asbestos in your home and plan to undertake renovations (including insulation or air sealing work) that may cause the vermiculite insulation or asbestos to be disturbed, contact professionals who are qualified to handle asbestos before you proceed with the renovations.

Combustion gases

The use of fuel-burning heating equipment can inadvertently lead to hazardous combustion gases being drawn into your home. Always consult a qualified heating and ventilation contractor when servicing or replacing this type of equipment and ensure you have a functioning carbon monoxide detector. Refer to the publication entitled *Combustion gases in your home: What you should know about combustion spillage* on Natural Resources Canada's website to learn more about combustion spillage.

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Natural Resources Canada does not endorse or make any representation of warranty as to the accuracy or applicability of the energy advisor's comments with respect to your particular home.

Natural Resources Canada does not endorse the services of any contractor, nor any specific product, and accepts no liability in the selection of materials, products, contractors nor the performance of workmanship.

The rating and potential savings in this report are based on the conditions of your home at the time of the evaluation and the use of EnerGuide standard operating conditions.

ADDITIONAL INFORMATION - CONTINUED

Along with the upgrade recommendations, here are some simple actions you can take to be more comfortable, save money and reduce GHG emissions:

ENERGY-SAVING TIPS

- ☐ Install and set-up programmable electronic thermostats to reduce the heating temperature at night and when you are away. For each degree of setback, you can save up to 2 percent on your heating bills.
- ☐ When replacing appliances, electronics and office equipment, look for ENERGY STAR® certified products. ENERGY STAR certified products are among the most efficient and use up to less than half as much energy in standby mode (i.e. when they are turned "off") than non-certified products. You can also look for the EnerGuide product label to help you select the most energy efficient model. For more information, go to *energystar.gc.ca*.
- ☐ Replace your light bulbs with ENERGY STAR certified ones, such as light emitting diodes (LEDs). They last longer and use less electricity.
- ☐ Insulate the first two metres of the hot and cold water pipes starting from the water heater with insulating foam sleeves or pipe wrap insulation. By doing so, you will save on your water heating costs and reduce your water consumption. For a fuel-fired water heater, maintain a 15 cm (6 in.) clearance between the water piping insulation and the vent pipe.
- ☐ If you use a block heater for your car, use a timer. Set the timer to turn on one to two hours before you plan to start your vehicle.
- ☐ Replace your kitchen and bathroom exhaust fans with ENERGY STAR certified exhaust fans vented to the outside.
- ☐ Install a timer on your bathroom exhaust fans so that the fans are not left running for extended periods of time.
- ☐ Install low-flow shower heads (rated at 7.6 litres per minute or less) and faucet aerators.
- ☐ Fix leaky faucets and outside hose bibs.
- ☐ Plug your entertainment systems and office equipment into power bars that can be easily turned off when equipment is not in use.

NOTES:

Questions about this report?

Please contact your energy advisor.

APPENDIX B - Solar Quote for Stick Frame Home

Solar Energy System-Site Report

Date: June 2022
Customer: [redacted]
Site Location: Poplar Park Road, Kispiox Valley, Hazelton BC.
Report Author: Tim Butement – Harbour Renewables Ltd.

Coordinates: [redacted]

Height of Location = 325m (approx.)

Site Access: Good access on gravel driveway.

Summer Sun Angle= 58 deg (June 21st)
Winter Solstice Sun Angle= 11 deg (Dec 21st)
Equinox = 35 deg (March 21st Sep 21st)

Site: Large farm property with 2 houses, large workshop, barns and outbuildings.

Figure 1- Overhead view of farm showing suns path during the Equinox

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Location of Solar Panels & Inverter

An excellent location is on one of the South West outbuildings. The building is next to hay fields and there are no nearby tall trees or other buildings that would cause any shading issues.

The panels will be flush mounted with the roof and on non-adjustable racking. This will mean snow coverage in winter and a loss of power generation. The generation in winter here is very low due to the lack of sun hours in the day. The snow could be cleared if the power was required through the winter.

A DC cable would run underground from the outbuilding to the house and the inverter and related electricals would be housed here. The inverter would be grid-tied into the house's sub panel in the basement.

Figure 2- Proposed location of Solar Panels, Cable run and Inverter

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Figure 3- Outbuilding to hold the roof top panels

Solar Generation

Estimates from various sources give the annual generation of solar in BC at 1100- 1200kWh per year for every kW of panels installed (3 panels at 340W each = 1,020Watts).
The majority of the power is generated in the summer, around 3 times that of winter. I have used the lower figure of 1100kWh per kW for the estimated annual generation, being in Northern BC.

The house and workshop use 27,500kWh of electricity per year on average, taken from previous BC Hydro bills.

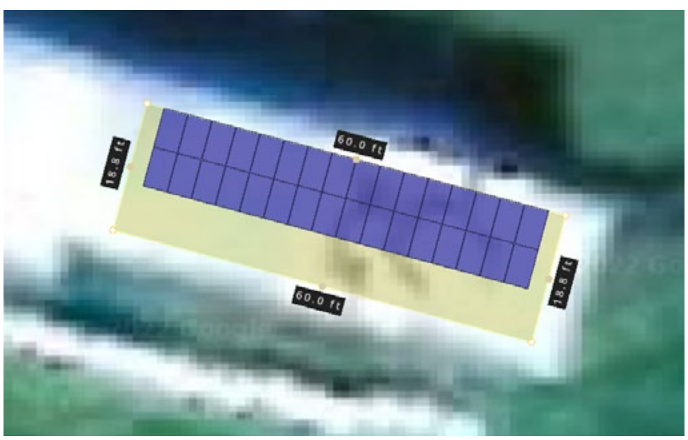

Figure 4- Possible Layout of 32 panels

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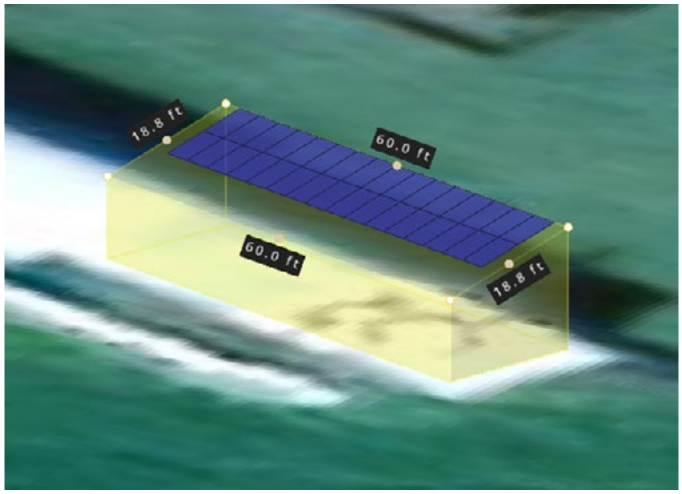

Figure 5- 3D view of Panel Layout

Incentives and Grants

Tax- There is 0% PST on a new solar system in BC. There is still 7% PST on batteries and their related parts if your system includes this.

Greener Homes Grant- Currently there is up to $5,000 available rebate on Solar Panels and Inverters. The grant is $1,000 per kilo Watt of solar installed, so 5kW of solar panels need to be installed to gain the full rebate. There is an additional rebate of $1,000 towards batteries for a solar system.
https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/start-your-energy-efficient-retrofits/plan-document-and-complete-your-home-retrofits/eligible-grants-for-my-home-retrofit/23504#s6

Net Metering- Once registered and approved for this, BC Hydro will credit your excess generation in from the panels in the summer and you can claim that credit back in the winter when your solar generation will be lower. Currently if on average your home uses 8000kWh of electricity per year and you generate 12,000 kWh a year after installing solar, you will not receive any money for the extra 4,000kWh you put into the grid. You would however have a $0 energy bill from BC Hydro.

Canada Greener Homes Loan- $5,000-$40,000 per household available on a 10-year interest free loan if used for renewable energy.
https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/canada-greener-homes-loan/24286

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Solar System Options

Option 1- On Grid- Medium Solar System

Solar = 5350Watts (x14 375Watt panels)
Inverter= 5000W

Estimated Annual Generation = 5775 kWh

Solar Panels & Racking = $6,510
Inverter= $1,950
Cables & Electricals = $2,428

Solar System Cost= **$10,648.00**
With Taxes = $11,180.40
Available Grants = $5,000

Total Cost= **$6,180.40**

Payback Years = 7 years *(based on $0.14 per kWh price)*
20-year Electricity Generation = $17,640

Option 2- On Grid-Large System

Solar = 15.36kW (x32 480Watt panels)
Inverter= 15kW

Estimated Annual Generation = 16,900 kWh

Solar Panels & Racking = $17,824
Inverter= $5,200
Cables & Electricals = $3,452

Solar System Cost = **$26,476.00**
With Taxes = $27,799.80
Available Grants = $5,000

Total Cost= **$22,799.80**

Payback Years = 8.8 years *(based on $0.14 per kWh price)*
20-year Electricity Generation = $47,310

Option 3- On Grid- Large Solar System with Battery Backup

Solar = 15.36 kW (x32 480Watt panels)
Inverter= 15kW Hybrid Inverter

Batteries= x8 L16 AGM Batteries
Storage Capacity = 21.6kWh
Usable Capacity (50%) = 10.8kWh

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Estimated Annual Generation = 16,900 kWh

Option- Back-up Generator: Automatic generator start options available. Requires a compatible generator.

Solar Panels & Racking = $17,824
Inverter= $12,500
Cables & Electricals = $3,452
Batteries & Components = $6,698

Solar System Cost = **$40,474.00**
With Taxes = **$**42,832.60
Available Grants = $6,000

Total Cost= **$36,832.60**

Payback Years = 15.6 years *(based on $0.14 per kWh price)*
20-year Electricity Generation = $47,310

Notes: prices subject to change and possible delivery surcharges depending on time of order. Costs based on a cable run of 200ft between the Solar Panels and the House. Cost of installation and electrician for connecting to the grid not included.

Recommendations

Option 1- is sized to maximise the available grants. It would provide 20% of the buildings electricity requirement.

Option 2- is using the largest inverter currently available (15kW), and sizing the panels and array to get the most out of the inverter. This should provide 60% of the buildings power requirements.

Option 3- takes into account the power outages in the Kispiox Valley while still feeding lots of power into the grid over the years. The additional battery backup would be used to run your well pump, lights and other chosen critical loads during a power outage. Again, this should provide 60% of the buildings power requirements.

Further Options- There are smaller Battery Back-Up inverters available in sizes 5kW and 12kW – this, with a smaller number of solar panels would reduce the overall investment cost.
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APPENDIX C - Solar Quote For Log Home

Harbour Renewables Ltd.				Date	25/04/2022
Quote for: Solar System- Grid Tied with Battery Back Up				Quote No:	115
Customer: Debbie McGhie		Address: Salmon River Road, Hazelton BC			
Overview- 11.25kW of Solar Power, 12kW Inverter power with 21.6kWhrs of battery storage.					
Notes: Foundations for racking to be installed at customers cost. Connection from Inverter to customers electrical panel to be completed by customers electrictian at customers cost.					
Item	**Item Description**	**HR PRICE**	**Unit**	**Amount**	**Total Cost**
PV Panels	Longi 375W Solar Panels- Black (11,250W total)	$ 340.00	Ea	30	**$ 10,200.00**
Racking	Ground Mount Racking System for x30 panels	$ 6,000.00	Ea	1	**$ 6,000.00**
	x5 10ft sections 50ft length				
Inverter	Sol-Ark 12k Inverter	$ 10,500.00	Ea	1	**$ 10,500.00**
Batteries	AGM 6V 2.7kW hour Batteries (No Maintenance)	$ 740.00	Ea	8	**$ 5,920.00**
	21.6kWh total (10.8kWh usable at 50% SOC)				
Cables & Components					
MC4 Connectors	Connector MC4 Neg	$ 4.00	Ea	2	**$ 8.00**
	Connector MC4 Pos (+)	$ 4.00	Ea	2	**$ 8.00**
PV Cables	MC Red Solar Module Positive Home Run Cable 20 foot - Red	$ 40.00	ft	2	**$ 80.00**
	MC Black Solar Module Negative Home Run Cable 20 foot - Black	$ 40.00	ft	2	**$ 80.00**
Rapid Shutdown	Rapid Shutdown Switch with Surge Protector	$ 1,250.00	Ea	1	**$ 1,250.00**
Cable	TECK Cable 600V. 10/4 (80 ft /25m length)	$ 18.00	m	25	**$ 450.00**
Battery Box	Box to hold x8 Batteries	$ 400.00	Ea	1	**$ 400.00**
Battery Cables	Five Foot, 2/0 Cable Pair	$ 140.00	Ea	1	**$ 140.00**
	00/1 Pre- Made Battery Cables - 16"	$ 34.00	Ea	7	**$ 238.00**
Cable- Grounding	6 AWG ground copper cable	$ 5.00	m	12	**$ 60.00**
Grounding Pole	Grounding Pole and Clamp	$ 15.00	Ea	1	**$ 15.00**
				Total	**$ 35,349.00**
				TOTAL	**$ 35,349.00**
	Note: Delivery to Customer	Delivery		Delivery	NO COST
		Taxes	0.1	GST	$ 1,767.45
	0% PST on Full Solar System (Panels, Inverter + Cables)		0	PST	$ -
	7% PST on Batteries & Cables		0.1	PST	$ 334.90
	**note: prices subject to change and possible delivery surcharges depending on time of order.*			**TOTAL**	**$ 37,451.35**

APPENDIX D - Solar Quote for Madii Lii

Quote

Harbour Renewables Ltd

Installation and maintenance of renewable energy systems.

2106 Kispiox Valley Road
Hazelton, BC
Telephone No: 250 842 3061

Email Address:timb@harbourrenewables.ca

DATE: August 2, 2022
Quote # 124

FOR: Solar System-Parts 43kWh batteries & 50ft TECK Cable
Bill To: Madii Lii
Luutkudziiwus Territory
Deliver To: Deliver to site

DESCRIPTION	AMOUNT
Batteries= L16 AGM 2.7kwh batteries @ $840 each x16 = $13,440	$ 13,440.00
TECK Cable 600V. 4 Core/ no.6 Cable @ $38 per m (50 feet/ 15.25 m length)	$ 579.50
Installaton of Solar System 3 days (24hrs) @ $60hr = $1,440	$ 1,440.00
Travel Time to Site 1hr each way @ 60hr. 3 round trips = $360	$ 360.00
SUBTOTAL	$ 15,819.50
Delivery	$ -
TOTAL	$ 15,819.50
GST 5%	$ 790.98
PST only on Batteries & Cables — *PST 7%*	$ 981.37
THANK YOU FOR YOUR BUSINESS! — ***TOTAL***	**$ 17,591.84**

Harbour Renewables Ltd
Corporation Number: 1228327-1

Payment Details
Bank:**Bulkley Valley Credit Union**
Account Name: **Harbour Renewables Ltd**
INTERAC e-Transfer to : **timb@harbourrenewables.ca**

END NOTES

[1]https://bearclawlodge.ca/

[2]https://www2.gov.bc.ca

[3]www.kispioxband.ca

[4]https://www.nrcan.gc.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/keeping-the-heat/15768

[5]For smaller-scale project participants, information on annual energy costs was provided. For larger-scale participants, information on average energy consumption was provided for homes of varying sizes, and referenced against provincial databased to estimate the average annual energy consumption and GHG emissions.

[6]Cords of wood are currently available in the Upper Skeena for $150-$300, depending on the size of the truck load. For the purposes of this analysis, an average value of $225 per cord was used based on this cost range.

[7]All values referenced from 2020 BC Best Practices Guide for Calculating GHG Emissions. https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2020-pso-methodology.pdf

[8]Value based on lower and upper threshold emissions values for a biomass system at 65% efficiency.

[9]Assumed to have 0% moisture content.

[10]Wood pellets assumed to have an energy content of 0.0197 GJ/kg as per RETScreen Expert Clean Energy Management Software.

[11]BC Hydro is considered a renewable source in this scenario as over 90% of the electricity generated by BC Hydro is from renewable energy sources.

[12]Greenhouse gas emissions: drivers and impacts - Canada.ca

[13]Referenced from https://app.bchydro.com/accounts-billing/electrical-connections/net-metering.html

[14]Cost estimates were developed based on recent quotes (secured in 2022) from local solar PV businesses, but prices are subject to change.

[15]The Canada Greener Homes Grant program currently offers homeowners up to $1,000 per kW of solar installed, up to a maximum of $5,000. These calculations assume that homeowners are accessing this funding to support the installation of their solar PV systems. Additional information on the grant program is available here - https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/23441

[16]IFRP Conf Boise ID Tad Mason 20120131.ppt (tssconsultants.com)

[17]It should be noted that in recent years, companies have been working to develop a wood pellet plant (Hazelton BioEnergy Ltd.) in the region. Additional information on this plant is available here: https://hazeltonbioenergy.com/. According to the Large BC Industrial Facilities map, two additional pellet plants exist in Northern BC: Smithers Pellet Limited Partnership, and the Houston Pellet Limited Partnership. Although not local to the Upper Skeena region, these locations represent potential opportunities for pellet purchase in Northern BC. https://public.tableau.com/app/profile/irc.gc.cas.bc/viz/BCIndustrialGHGPublicReports18-Oct-2021/Main

[18]Health Impacts of Diesel Exhaust (metrovancouver.org)

[19]Rebates, Incentives & Grants for Installing Solar Power in British Columbia (BC) | Empower Energy Solar

[20][PDF] Pursuing Sustainability: A Case for Regional Approach (researchgate.net)

[21][PDF] Pursuing Sustainability: A Case for Regional Approach (researchgate.net)

PHOTO CREDITS

Pg. 4. Child in Community. Photo by Aaron Vincent Elkaim.

Pg. 8. The Mighty Skeena. Photo by Monty Stevens.

Pg. 12. Aerial view of Hazelton, BC. Photo by Steve McPhail - Liquid Elements.

Pg. 14. Kispiox Band Office & Kispiox Totems. Photo by Jennifer Bullied

Pg. 17. Madii Lii Culture Camp. Photo by Pansy Wright Simms

Pg. 18. Sik E Dakh Band Office. Photo by Jennifer Bullied

Pg. 20. Douglas Ranch, BC. Photo by Tjflex2. www.creativecommons.org. CC-BY-2.0

Pg. 21. Salmon River Ranch and Mechanical (Home and Shop). Photo by Deb McGhee

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Pg. 22. Small house (modified). Photo by Pexels.com

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Pg. 35. Fireplace at Bear Claw Lodge. Photo by Bear Claw Lodge.

Pg. 36. Solar PV System at Bear Claw Lodge. Photo by Bear Claw Lodge.

Pg. 38. Kispiox New Housing. Photo by Jennifer Bullied

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Pg. 55. (Upper left). Close up of a solar panel. Photo by Los Muertos Crew. www.pexels.com.

Pg. 55. (Upper right). Hupacasath First Nation' Run-of-river 'renewable energy' hydro BC 'Port Alberni. Photo by Green Energy Futures. www.creativecommons.org. CC-BY-2.0

Pg. 55. (Lower left). Wind Energy. Photo by Markus Distelrath. www.pixabay.com

Pg. 55. (Lower right.) INL researchers are studying ways to economically collect, transport, densify and formulate raw bio-mass that will feed into a biofuels production facility. Photo by Idaho National Laboratory. www.creativecommons.org. CC-BY-2.0

Pg. 60. Same as previous page.

Pg. 57. Close up of a solar panel. Photo by Los Muertos Crew. www.pexels.com.

Pg. 59. Roof Mounted Systems. Photo provided by Urban Systems.

Pg. 60. Ground-Mounted Systems. Photo provided by Urban Systems.

Pg. 65. Hupacasath First Nation' Run-of-river 'renewable energy' hydro BC 'Port Alberni.. Photo by Green Energy Futures. www.creativecommons.org. CC-BY-2.0

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Pg. 78. Skeena in the Winter. Photo by Monty Stevens.

Pg. 81. Hazelton Learning Shop. Photo by Jennifer Bullied

Pg. 83 Sun rays beating down on mother and daughter walking in the forest. Photo by James Wheeler. www.unsplash.com

Pg. 84. Hands on tree. Photo by Shane Rounce. www.unsplash.com

Skeena Watershed
Conservation Coalition