Quatsino First Nation

Community Energy Plan

Rev 1.0

March 2019

Reviewed and Approved by:

Signature -

Name -

Position -

Date -

Prepared in collaboration between:

Barkley project group

With contributions from:

UVIC

SRM PROJECTS

Fathom Scientific Ltd.
1561 Whitesails Dr.
Bowen Island, B.C.
V0N-1G2 +1.604.612.5501
www.fathomscientific.com

HAKAI EnergySolutions

FOCUSED ENERGY ASSESSMENTS

BC Hydro Power smart

And funding support from:

NEW RELATIONSHIP TRUST FOUNDATION

FCM FEDERATION OF CANADIAN MUNICIPALITIES

BRITISH COLUMBIA

Table of Contents

List of Figures

List of Tables

Executive Summary

The Community Energy Plan (CEP) for QFN was created to identify energy efficiency opportunities for residential and community buildings and renewable energy development prospects within QFN's Traditional Territory. The CEP process was guided by community-identified goals and ongoing feedback. This document is supported by audits and assessments completed by energy efficiency and renewable energy professionals.

Community energy goals were identified as: decreasing the cost of energy bills, increasing the energy efficiency of homes and buildings in our community, and developing renewable energy in our territory.

EnerGuide Audits (EGAs) were completed in 24 residences, providing a detailed summary of current energy trends, energy efficiency opportunities, and potential savings. The results were then compiled and summarized to create a list of priority housing items for the Nation. EGAs identified energy saving opportunities that would save an average of 10,072 kWh/year per home. The majority of homes would benefit from: air sealing (100%), heat pump installations (91%), windows and/or door replacements (95%) and greater insulation in foundations (89%) and attics (55%).

ASHRAE Level 2 audits were completed for the health centre, K'ak'otlats'i school, community hall and daycare. These audits identified many energy saving initiatives including: replace health centre boiler tanks with heat pump hot water tanks, install a central heat pump system in the community hall, and complete lighting retrofits at the health centre, school, and community hall.

The Energy Conservation Assistance Program (ECAP) completed installation in 11 homes, resulting in estimated savings of $2,378/year resulting. These included: installation of LED light bulbs, hot water tank pipe insulation, weather-stripping and tap aerators.

Renewable energy opportunities were assessed to identify development options within Quatsino Traditional Territory. It was determined that there are ample opportunities for renewable energy generation projects including several run-of-river hydropower projects, high potential wind areas, solar photovoltaic, and wave energy. The next steps for each option are identified within the implementation plan and include: development of a hydrometric program, installation of a MET tower with anonmeter to acquire wind data, secure funding for solar photovoltaic on the community hall, and create a strategy team to progress wave energy.

The implementation plan identifies short-term, mid-term, long-term, and ongoing energy-related opportunities for both energy efficiency and renewable energy recommendations.

1 Introduction

This Community Energy Plan (CEP) has been developed by Quatsino First Nation (QFN) to provide a guiding framework for renewable energy development and energy efficiency initiatives.

The detailed objectives of developing and maintaining this CEP include:

- Develop an energy plan that aligns with ongoing community planning;
- Determine energy-related goals and priorities of Quatsino members;
- Measuring and summarizing current community energy demand;
- Calculate Quatsino First Nation greenhouse gas emissions baseline;
- Forecast future community energy demand;
- Evaluate energy efficiency opportunities and calculate potential savings for residences and community buildings;
- Identify and compare opportunities for renewable energy generation, including:
    - run-of-river hydropower
    - wind power
    - wave power
    - solar photovoltaic
- Summarize relevant funding opportunities; and,
- Create a realistic implementation plan

2 Methodology

This CEP was developed based on community engagement, existing community planning documents, 3 years of daily BC Hydro consumption data, input from renewable energy generation specialists, participation in the *Energy Conservation Assistance Program* (ECAP) and EnerGuide energy audits.

The scope of the CEP project was broadly defined through the course of community planning meetings. The scope was further defined during focused meetings taking into consideration resources available and priorities identified by the community through other planning initiatives. Quatsino First Nation (QFN) has invested considerable resources in developing and maintaining documents and framework to guide community development and growth including:

- Land Use Plan (2019- *draft*)
- Strategic Plan for Governance (2012)
- Comprehensive Community Plan (2013)

Renewable energy resource assessments included an inventory of hydropower generation opportunities, a pre-feasibility study of solar photovoltaic resources, a wind resource assessment, and a wave energy power analysis. Short-term energy efficiency opportunities were identified and implemented through the ECAP program. Current energy consumption trends and energy efficiency opportunities were identified during EnerGuide energy audits of 24 residences by a Certified Energy Auditor. ASHRAE Level 2 audits were also completed for 4 community buildings.

A summary of engagement and milestones is provided in Table 1. Contributors to the CEP process are summarized in Table 2.

Table 1: Summary of Engagement and Milestones

Date	Details
2017-07-04	New Relationship Trust (Approval $24,750 – DIR036JUN17)
2017-10-11	BC Rural Dividend (Approval $9,901 – 2017050116)
2017-12-04	QFN / RDMW Meeting
2018-01-08	FCM Application Completed
2018-02-26	Leadership update (general)
2018-03-16	Leadership update (general)
2018-03-29	BC Rural Dividend (Extension Approval)
2018-04-13	Leadership update (general)
2018-04-16	Status Report: March – April 2018
2018-04-17	New Relationship Trust (Extension Approval)

2018-05-30	CEP Leadership Meeting
2018-06-28	CEP Leadership Meeting
2018-07-03	HydroRecon Initiated
2018-07-23	Wave Assessment Initiated
2018-08-02	Status Report: August 2018
2018-09-05	CEP Community Vision Workshop
2018-09-07	FCM (Approval $46,400 – MCIP 15801)
2018-09-07	Leadership update (general)
2018-09-14	Status Report: August to September 2018
2018-11-13	Wind Assessment Complete
2018-12-05	Leadership update (general)
2018-12-12	Leadership CEP Update (energy audits/ECAP-specific)
2018-12-20	Wave Power Assessment Complete
2019-1-19	Leadership update (general)
2019-02-06	HydroRecon Complete
2019-02-09	Solar Photovoltaic Assessment Complete
2019-02-18	Draft CEP Complete
2019-02-19	Community Meeting – Draft CEP Feedback
2019-03-15	GHG Emissions Inventory Complete
2019-04-01	Revised CEP Complete (Final)
Ongoing	Communication with Quatsino’s CEP Community Champion

Table 2: Summary of Contributors

NAME	COMPANY	ROLE	DESCRIPTION
Stephenie Hunt	QFN	Community Champion/Liaison	Stephenie Hunt is Director of Housing at Quatsino First Nation
James Redford	QFN	Community Champion/Liaison	James Redford is Director of Lands and Resources at Quatsino First Nation.
Jodi Boyd	QFN	Community Champion/Liaison	Jodi Boyd was Band Manager at Quatsino First Nation when the project was initiated
Mary Vasey and BPG CEP Team	BPG	Project Management, Analysis, & CEP Report	Project management, technical review, community engagement, compiled/finalized CEP report
Tim Matthews Gabe Sentlinger	BPG Fathom Scientific Ltd.	HydroRecon	Created an inventory of, and evaluated, hydropower resource development opportunities within Quatsino's traditional territory
Scot Meriam, P.Eng.	SRM Projects	Wind Assessment	Performed wind power analysis within Quatsino's traditional territory.
Brad Buckham and PRIMED Team	University of Victoria	Wave Assessment	Completed detailed wave power assessment for waters within Quatsino's traditional territory
Darrell Eason	Focused Energy Assessments	Energy Auditor	Conducted in-depth energy audits of 23 homes and 4 commercial buildings within the QFN community to identify opportunities for increased energy efficiency.
Ashleigh Kolla Tammy Tait	Carillion Services It's On Electric!	ECAP Outreach Coordinator	Outreach Coordinator for Vancouver Island for the Energy Conservation Assistance Program, a partnership between BC Hydro and Fortis BC.

3 Community Vision

QFN has participated in several planning initiatives that focus on different aspects of community development and priorities. To support development of the Comprehensive Community Plan. Community visioning workshops occurred in March 2011.[1] During these workshops the community identified a Vision Statement and Guiding Principles. It is important for the CEP to be developed and considered within the context of these fundamental community philosophies.

5.1 Vision Statement

"We, the Quatsino First Nation, proud descendants of the Gusgimukw who were placed on these lands by the Creator, have persevered throughout time by valuing our traditions and people and by continually exercising our inherent right to the lands and resources of our traditional territory. Through resilient leadership, consistent communication and working together we will empower our community to strive forward and succeed in reviving and rebuilding our unique language and culture, strengthening our governance structures and providing equitable services and opportunities that create a vibrant, healthy community that is self-governing, prosperous, supportive and carries our growing knowledge forward for future generations."

5.2 Community Values

Quatsino community values identified during the March 2011 Community Visioning Workshops:

- Honesty
- Faith
- Self-Esteem
- Responsibility
- Perseverance
- Love
- Empowerment
- Respect
- Family
- Pride
- Strength
- Humour
- Togetherness
- Loyalty
- Communication
- Community
- Sharing
- Courage
- Health
- Unity
- Integrity
- Harmony
- Humbleness
- Caring
- Education
- Recognition
- Knowledge
- Culture
- Traditional Language
- Recognition
- Laughter
- Equality

[1] Quatsino First Nation Comprehensive Community Plan. March 2013.

4 Community Energy Goals

A community energy survey was conducted in September 2018 during a QFN community meeting to assess community energy goals. The survey showed that homes are currently heated through a combination of electricity and wood. Energy bills are not currently affordable and the community strongly felt that making homes and community buildings more energy efficient, and therefore more affordable, should be a priority for the community. The majority of respondents at 76% felt that we should develop renewable energy projects within our traditional territory; 16% were neutral and 8% disagreed or strongly disagreed.

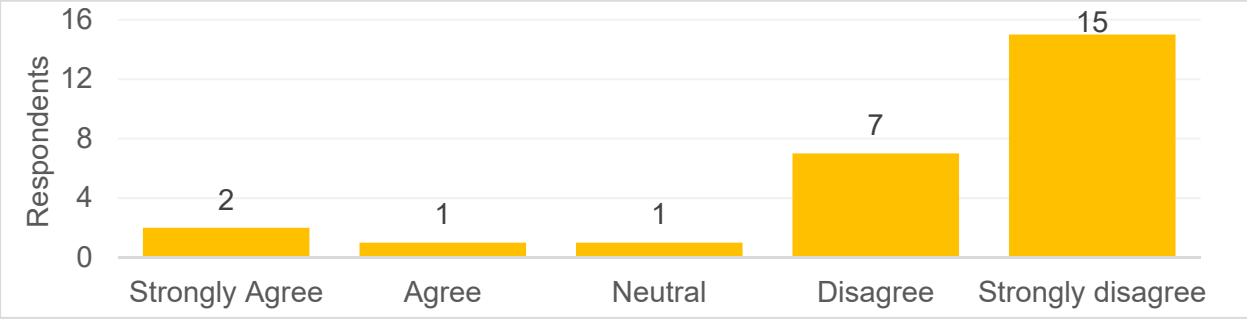


Figure 1: Quatsino response to the statement "My energy bills are affordable"

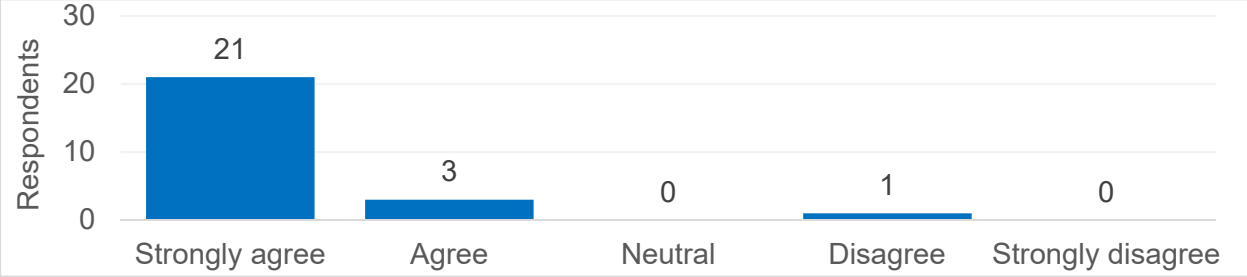


Figure 2: Community response to the statement "Making our homes more energy efficient should be a priority for our community"

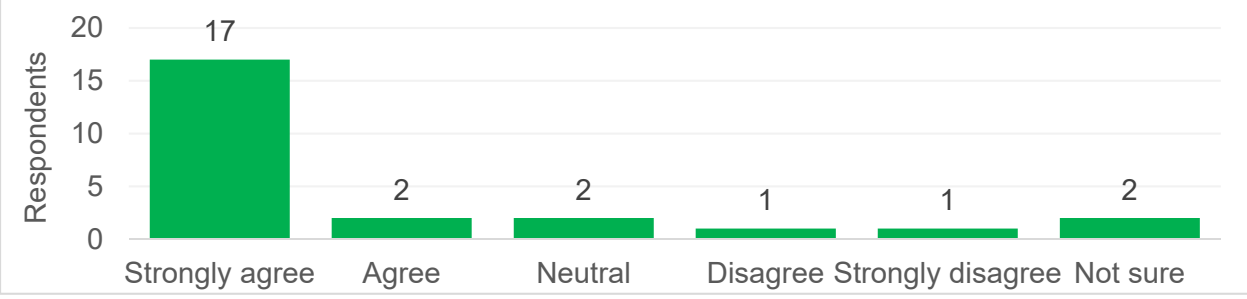


Figure 3: Community response to the statement "We should develop renewable energy projects in our territory"

During the initial community meeting in September 2018 QFN members also expressed an interest in the development of our community recycling program. Specific to renewable energy projects, the community expressed a need to address traditional practices, animal/fish use, and QFN inclusion throughout the project process. In addition, QFN expressed interest in being the owner of renewable energy projects within the traditional territory.

In February 2019 a draft CEP was available to all QFN members for feedback and the findings were presented at a community dinner. This event included a substantial feedback component. The results of this feedback are incorporated into the recommendations and throughout the report.

5 Community Profile

5.1 Regional Context

There are 20 Quatsino First Nation reserves on northern Vancouver Island, though community buildings and residences are concentrated in Quatsino Village (IR Quatsino Subdivision 18), 2 km north of Coal Harbour. [2] This community is 34 kilometres southwest of Port Hardy and is road accessible.

According to federal workforce datasets, the primary industry in the region is: [3]

- Agriculture (25.0%)
- Health care and education (25.0%)
- Manufacturing and construction (15.0%)
- Transportation (10.0%)

The remaining workforce is classified as other services (25.0%). This dataset also indicates that the most common occupations for Quatsino community members are trades (24.0%), social sciences and government (19.0%), and management (19.0%).[4]

[2] Government of Canada. 2018. Quatsino First Nation Profiles – Reserves/Settlements/Villages. Accessed December 2018.
[3] Government of Canada. 2018. Workforce Characteristics. Accessed December 2018.
[4] Government of Canada. 2018. Workforce Characteristics. Accessed December 2018.

5.2 Territory

Quatsino First Nation is made up five Kwakwaka'wakw tribes, the: Giopino, Hoyalas, Klaskino, Koskimo and Quatsino. The "Place of Origin" for the Quatsino people is Xwatis (Hwates), in Quatsino Sound.[5] The Nation's main reserve (Quatsino Subdivision 18) is just north of Coal Harbour and is where the health centre, school, and administration offices are located. In total, QFNs 20 reserves amount to 402.7 hectares of land, see Figure 4 and Figure 5.[6] Quatsino traditional territory spans the northwest corner of Vancouver Island totalling ~3,000 km^2.

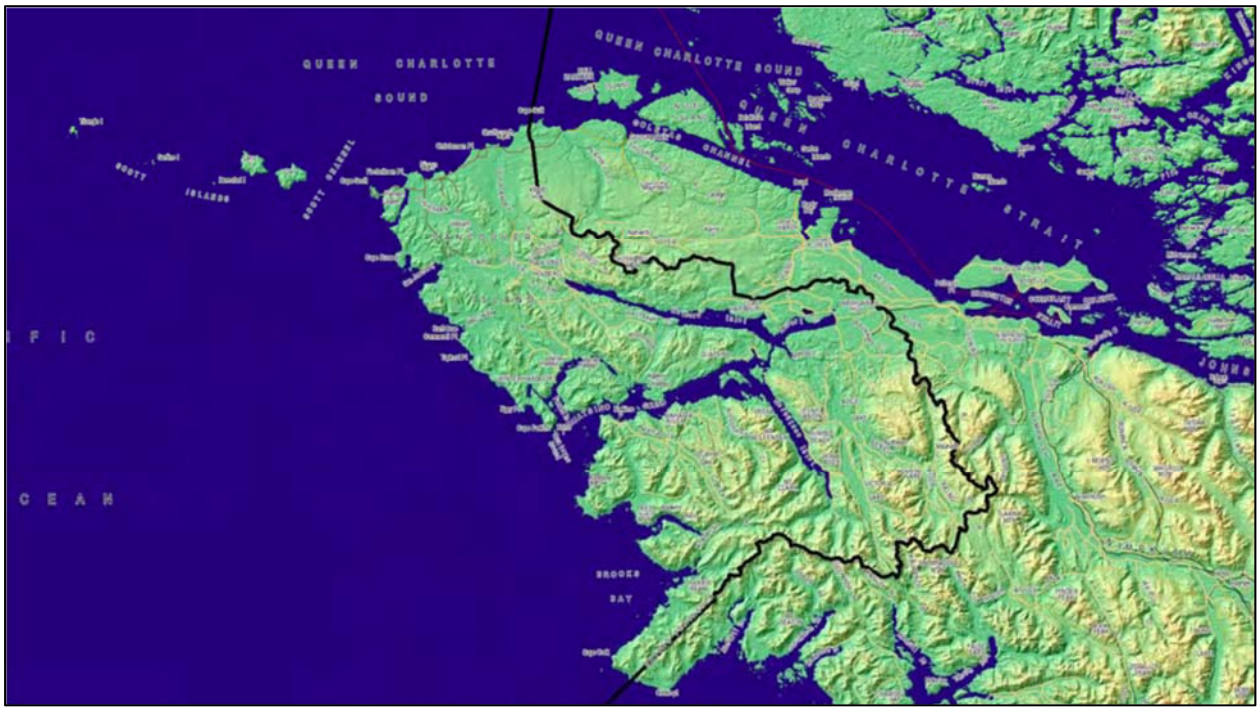


Figure 4: Quatsino Traditional Territory and renewable energy assessments study area

[5] Quatsino First Nation Comprehensive Community Plan. Page 10. March 2013.
[6] Government of Canada. 2018. Profiles: Quatsino First Nation. Accessed December 2018.

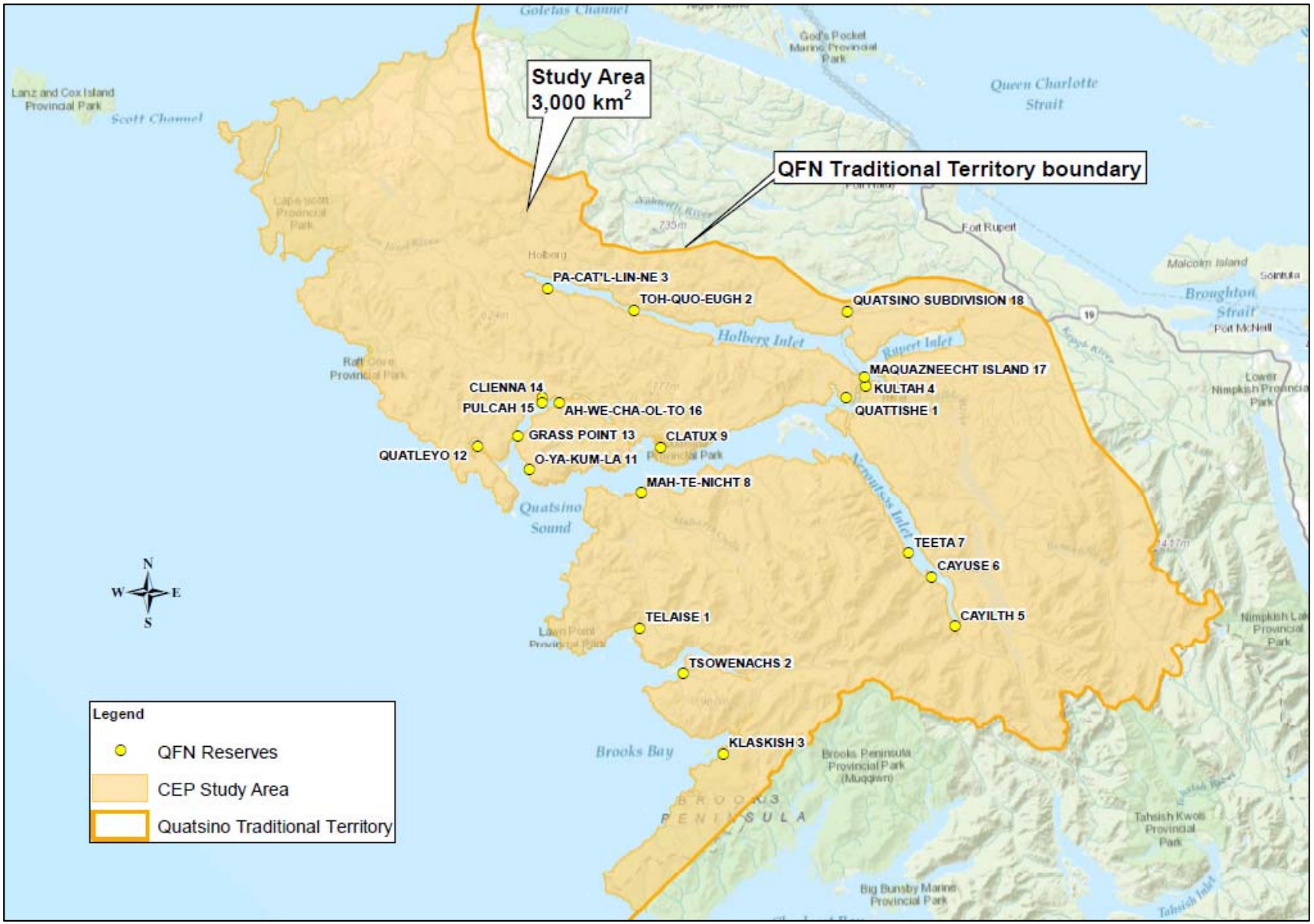


Figure 5: Quatsino traditional territory and location of 20 reserves; traditional territory boundary depicts study area.

5.3 Population

QFN has a registered population of 567 members as of March 2017 (Table 3).[7]

Table 3: QFN registered members

Type	Registered Members
On-Reserve	237
Off-Reserve	311
Other Reserves	19

5.4 Climate

Located within the Vancouver Island Maritime climatic zone, Quatsino experiences large amounts of rainfall from October to January, with temperatures averaging between 1 – 10 degrees Celsius. Summer months are typically warm and dry (Figure 6), with temperatures averaging 15 degrees Celsius. The average annual hours of daylight and average cloud cover in Quatsino can be seen in

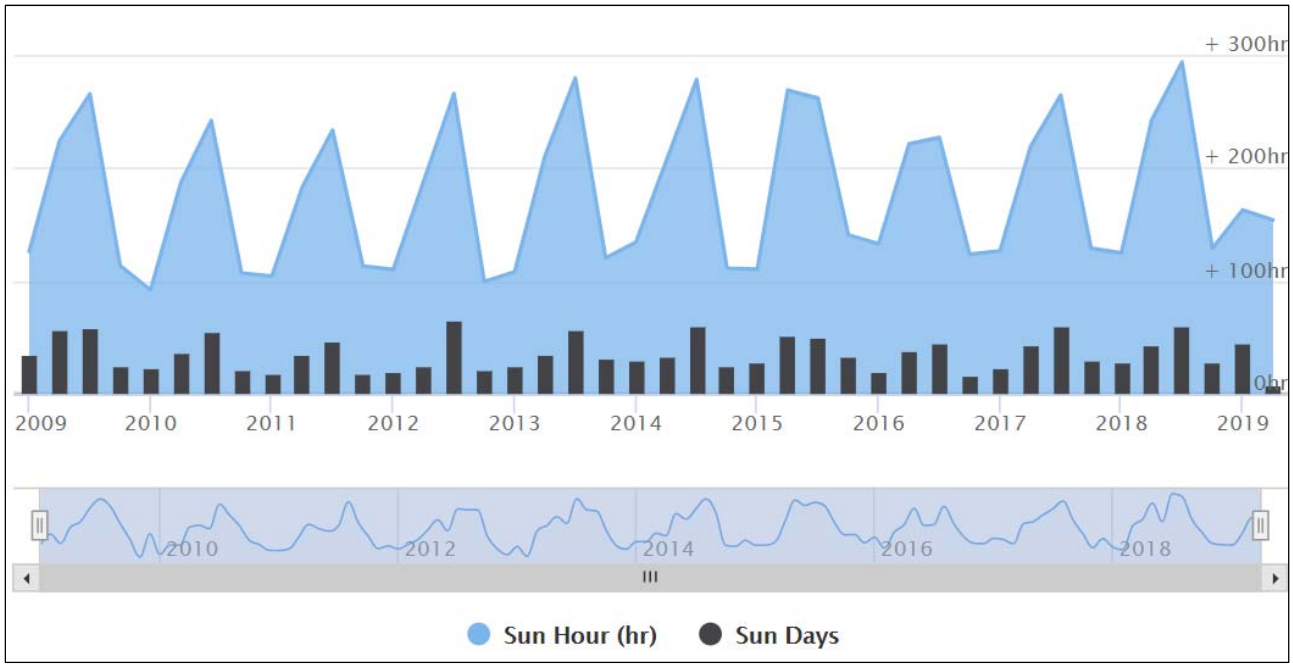


Figure 7: Quatsino average sun hours and sun days.

[7] Government of Canada. 2018. First Nation Profiles: Quatsino First Nation. Accessed December 2018.

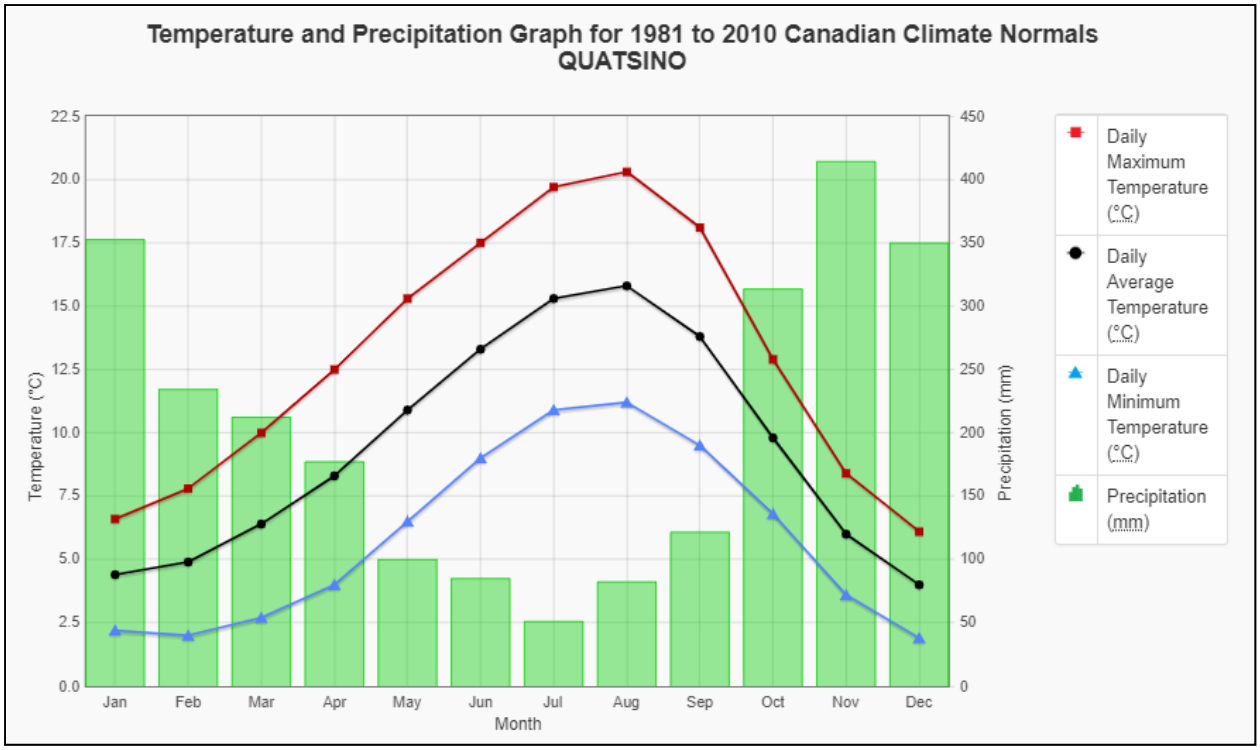


Figure 6: Quatsino average rainfall amount (mm) and average temperatures.[8]

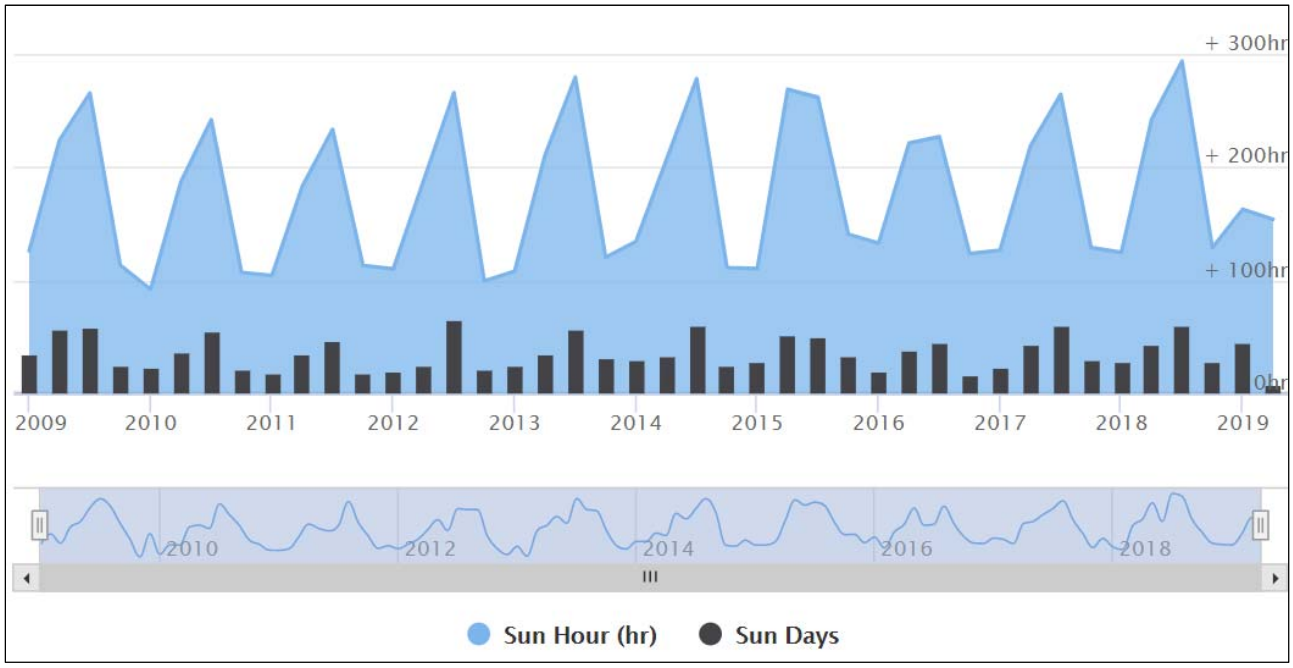


Figure 7: Quatsino average sun hours and sun days[9]

5.5 Governance

Quatsino Chief and Council are selected through a term-based electoral system. The current Chief and Council are listed below in Table 4. An overview of the governance goals and objectives identified in the Comprehensive Community Plan are summarized in Table 5.

Table 4: Summary of Chief and Councillors[10]

Title	Name	Appointment Date
Chief	James Nelson	04/17/2018
Councillor	Patricia Hall	04/17/2018
Councillor	Percy Nelson	04/17/2018
Councillor	Richard Nelson	04/17/2018
Councillor	James Wallas	04/17/2018
Councillor	Dawn Willie	04/17/2018

[8] Government of Canada. 2018. Temperature and Precipitation Graph for 1981 to 2010 Canadian Climate Normals Quatsino. Accessed December 2018.
[9] World Weather Online (2018). Quatsino average sun hours and sun days. Accessed December 2018.
[10] Government of Canada. 2018. Profiles: Quatsino First Nation. Accessed December 2018.

Table 5: Summary of governance objectives from Comprehensive Community Plan[11]

Goal	Objectives
Strengthen the capacity, autonomy, efficiency, transparency and strategic direction of Quatsino First Nation governance	Improve the frequency and transparency of communication between QFN Leadership and Membership
	Clarify and implement comprehensive policies and procedures to guide the day-to-day operations of QFN governance
	Enhance the delivery of services to QFN membership through planning
	Consult with membership on options to increase the autonomy of QFN governance
Strengthen the clarity, transparency and strategic direction of the QFNEDC and QFN relationship	Clarify, formalize and strengthen the working relationship between QFNEDC and QFN Chief and Council
	Strengthen and support the long-term strategic direction of QFNEDC
Foster bylaw development as a means of regulating economic and social activity within the QFN community	Research, analyze and develop on-reserve bylaws
Strengthen the capacity of QFN to manage relations with external government and non-government organizations and corporations	Develop processes and capacity to manage relationships with external stakeholders

5.6 Economy

Economic Development has been identified by community members as a priority for Quatsino First Nation. The QFN Economic Development Corporation (QFNEDC) was created in 2007 and has entered into a limited partnership agreement with QFN. Subsequently, the community is able to separate business decisions from political and funding decisions. This separation allows for community leadership and funding to focus on supporting programming, services, culture, language, and traditions.

QFNEDC has a Board of Directors, with a manager position created to oversee business decisions and laisse with community members to ensure there is benefit for QFN. The vision and mission for QFNEDC was highlighted in the March 2013 CCP document as follows:

Vision Statement of QFNEDC[12]

"To enhance the economic viability of the Quatsino First Nation"

Mission of QFNEDC

"The QFNEDC will support and foster viable, sustainable business and community growth"

The following entities have been created under QFNEDC:

- Quatsino Community Society
- Industrial Park - 688357 BC LTD
- QFN Marine Limited Partnership
- Quatsino Forestry Limited Partnership
- Gilakasla Kwa Holdings Ltd.
- Quatern Forest Products Limited Partnership
- 3 Nations Construction Limited Partnerships and 3 Nations Construction Ltd.
- Quattishe Forest Products Ltd.

Error! Reference source not found. and Table 7 are excerpts from the Comprehensive Community Plan outlining goals and objectives for Economic Development and Land and Resources, respectively:[13]

Table 6: Economic Development Goals and Objectives

Goal	Objectives
Strengthen the clarity, transparency and strategic direction of the QFENEDC and QFN relationship	Clarify, formalize and strengthen the working relationship between QFNEDC and QFN Chief and Council
	Strengthen and support the long-term strategic direction of QFNEDC

[11] Quatsino First Nation Comprehensive Community Plan. Page 34-36. March 2013.
[12] Quatsino First Nation Comprehensive Community Plan. Page 47. March 2013.
[13] Quatsino First Nation Comprehensive Community Plan. Page 53-56. March 2013.

Table 7: Land and Resources Goals and Objectives

Goal	Objectives
Strengthen the capacity transparency and autonomy of QFN to manage land and resources within QFN traditional territory	Strengthen the capacity of QFN to manage land resources within QFN traditional territory
	Increase the visibility of QFN in managing the lands and resources within QFN traditional territory. Review, revise and implement policies, procedures and plans
	Improve communications and collaboration with other departments, community and Chief and Council

6 Energy Profile

In order to understand the energy usage within the community an energy baseline is established. The baseline is an estimate and is based on results from EnerGuide Audits for residential buildings and 2017/2018 energy consumption records for 4 community buildings. This baseline is used as a benchmark to compare future changes in energy consumption. It is also used to calculate potential energy and cost savings from energy initiatives in the community.

5.1 Community Buildings and Infrastructure

Energy baseline data from 2017/2018 for the community hall, daycare, health centre, and K'ak'otlats'i school are summarized in Figure 8**Error! Reference source not found.** and totals 440,547 kWh.

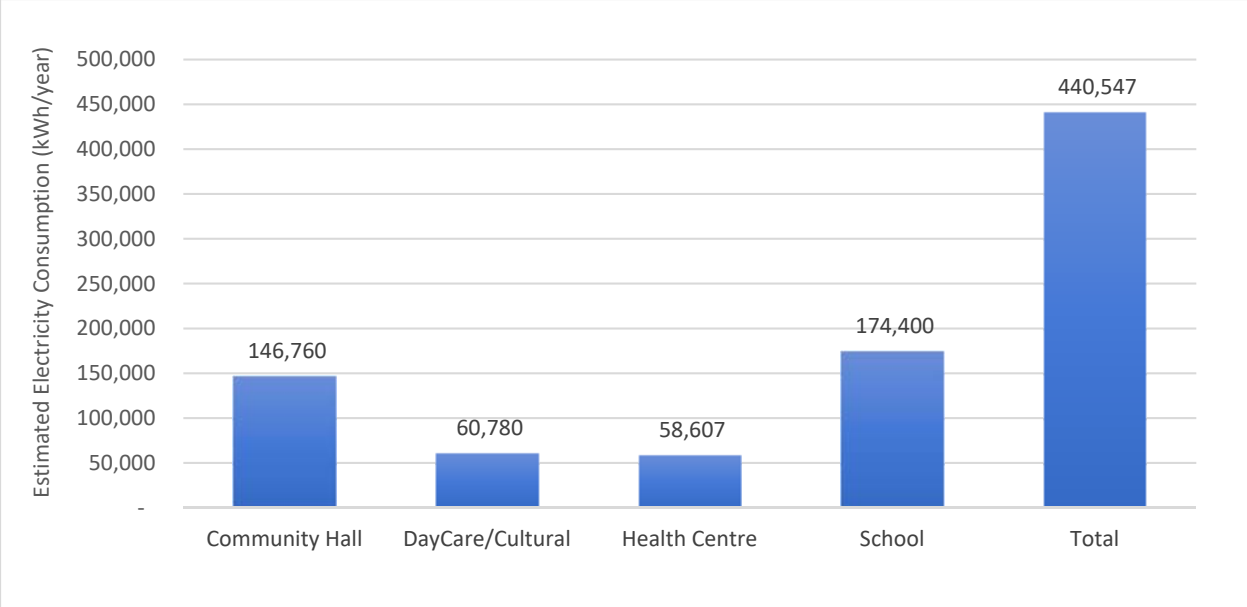


Figure 8: Electricity Consumption of Community Buildings

5.2 Residential Buildings

The residential energy consumption baseline was calculated based on energy consumption estimates from EnerGuide audits completed for 24 residences. The following are the addresses of the homes that participated in the EnerGuide assessment:

416 Kwatleo Rd	*110 Teeta Rd*	*329 Quattishe Rd*
307 Quattishe Rd	*105 Teeta Rd*	*312 Quattishe Rd*
500 Kwatleo Rd	*209 Clienna Rd*	*205 Clienna Rd*
327 Quattishe Rd	*318 Quattishe Rd*	*337 Quattishe Rd*
325 (Unit B) Quattishe Rd	*448 Quattishe Rd*	*203 Clienna Rd*
316 Quattishe Rd	*315 Quattishe Rd*	*322 Quatishe*
331 Quattishe	*217 Clienna Rd*	*335 Quattishe Rd*
412 Kwatleo Rd	*212 Clienna Rd*	*320 Quattishe Rd*

Electricity consumption estimates per home ranged from 7,756 to 32,267 kWh/year, with an average of 22,164 kWh/year (Figure 9). This is more than double the provincial average of 11,000 kWh/year. The total energy consumption for QFN residential housing is estimated by multiplying the average consumption per household (22,164 kWh/year) by the 75 homes in the community, which equates to 1,622,300 kWh/year or approximately $193,641/year based on current BC Hydro Tier 1 and Tier 2 rates.[14,15]

Notably, the provincial average energy consumption includes condominiums, which typically have lower overall energy consumption than the average residential home. Other factors that impact energy consumption include: housing quality and age, HVAC systems, age and type of appliances, electronic plug loads (eg. TV), lighting specifications, number of occupants per home, age of residents, and daily use patterns.

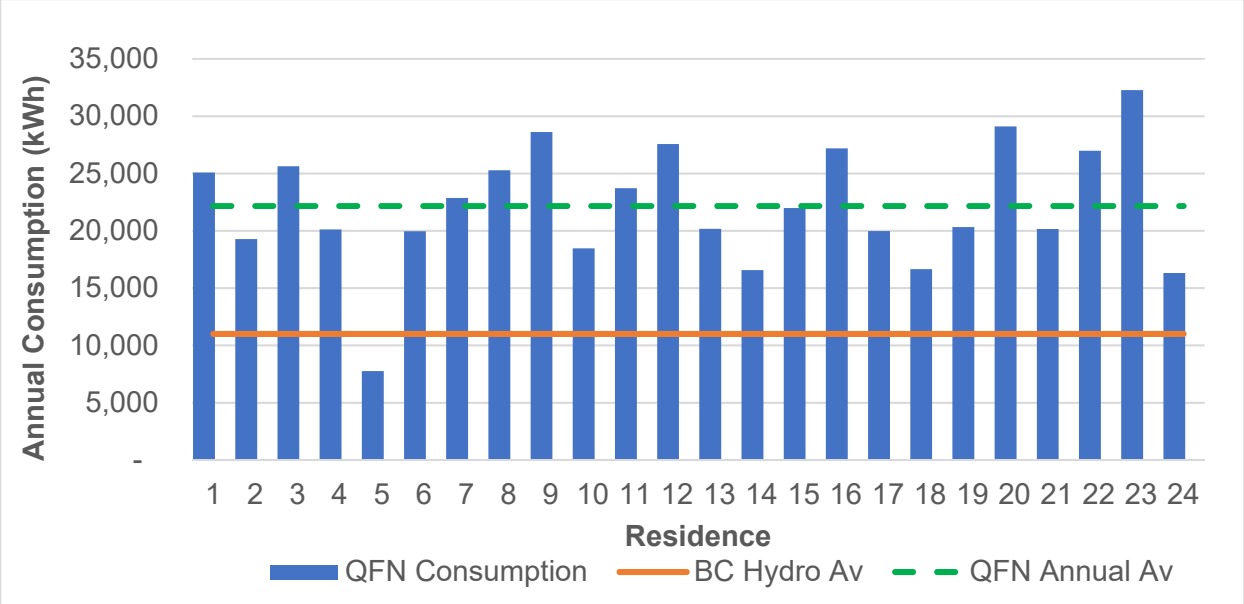


Figure 9: QFN average electricity consumption of residents (2017-2018) compared to BC Hydro average residential consumption (kWh/year)

BC Hydro residential customers pay a stepped tier rate for electricity consumption:

- Tier 1 rate is $0.0884/kWh for first 1,350 kWh for each two-month billing period
- Tier 2 Rate is $0.1326/kWh for usage above the Tier 1 threshold[16]

For residences with an equal payment plan, Tier 1 is based on the first 675 kWh per monthly billing period.

Based on estimated consumption, Tier 2 rates accounted for an average of 63% of the annual consumption for residences (Figure 1). Subsequently, 72% of annual electricity costs for residents are due to Tier 2 rates.

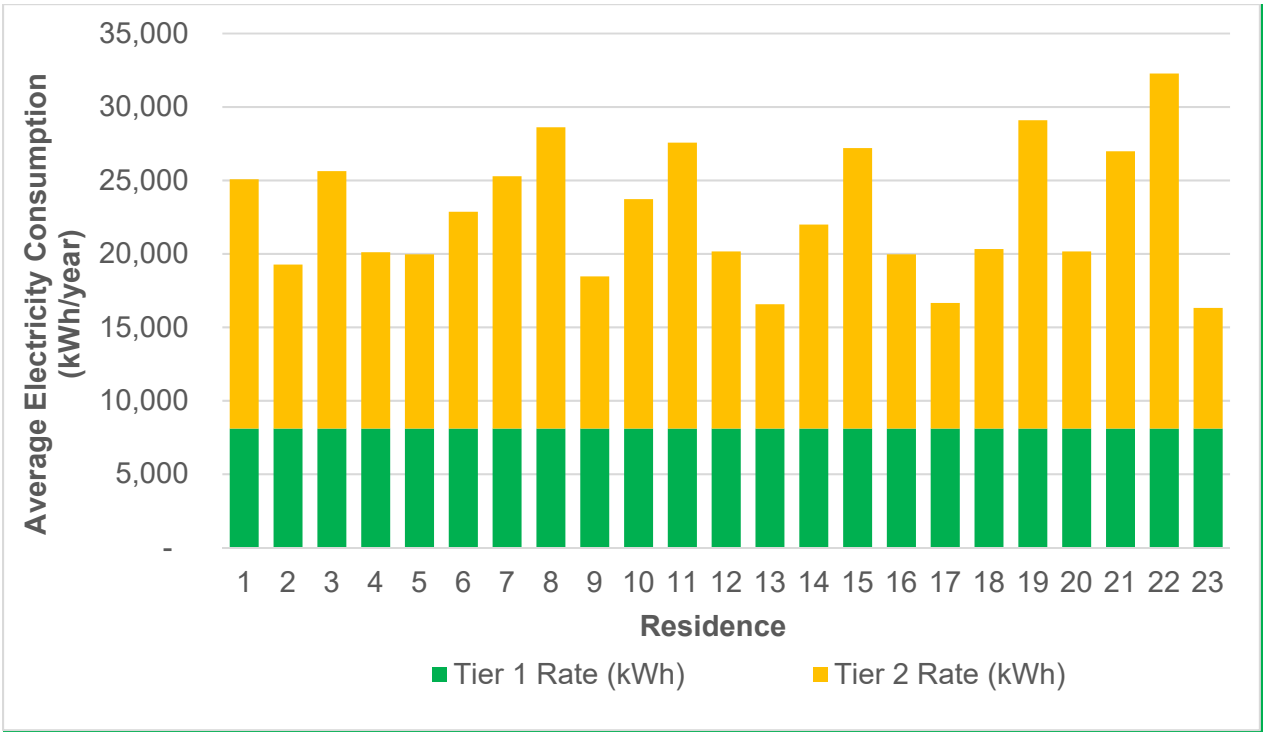


Figure 10: Average residential electricity consumption rates (kWh/year)

This indicates that the Tier 2 rate of $0.1326/kWh can be used to calculated financial savings from energy efficiency programs.

[14] Government of Canada 2018. Quatsino - Household and dwelling characteristics. Accessed December 2018.
[15] Average community BC Hydro bill calculated using Tier 1 & 2 rates
[16] BC Hydro (2018). Residential Rates. Residential Conservation Rate. Accessed December 2018.

5.3 Current Electricity Consumption (Community)

Based on data from the preceding sections, the total estimated electricity consumption for the community is 2,102,847 kWh/year with community buildings accounting for 21% and residences 79% (Figure 9).

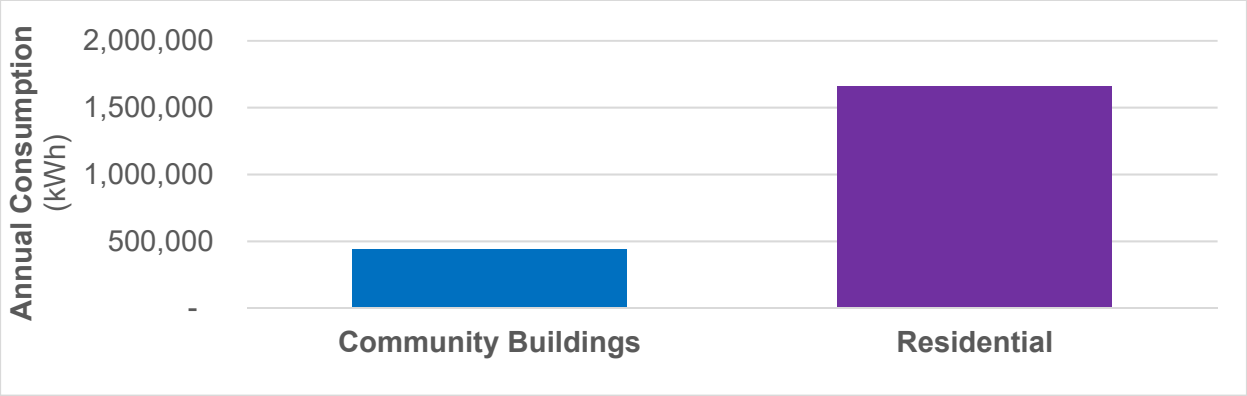


Figure 11: Estimated community electricity consumption (kWh/year)

5.4 Electricity Load Forecast

The electricity forecast is based on the project average annual growth rate of Indigenous populations on-reserve. Calculations assume a growth rate of 1.7% between 2019 and 2024, and 1.5% between 2024 and 2029.[17] Applying these rates, it can be estimated that by 2029 the total annual electricity consumption for QFN may reach 2,140,368 kWh/year (Figure 12). This does not consider any economic development projects or energy saving initiatives undertaken by QFN community members within this forecasted period.

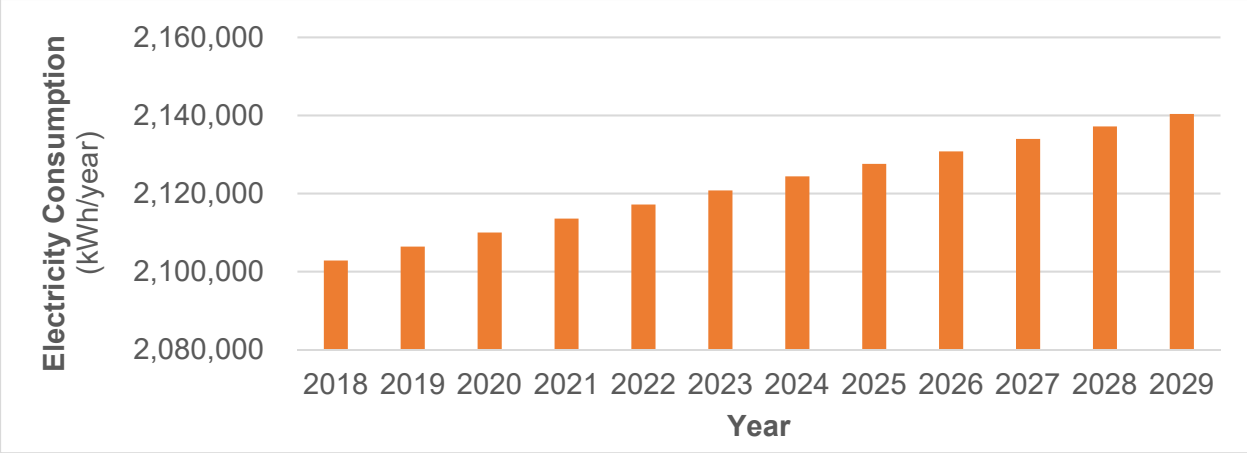


Figure 12: Forecasted community electricity consumption (kWh/year).

[17] Indigenous and Northern Affairs Canada (2018). Projected Average Annual Growth Rate of The Registered Indian Population, Medium Growth Scenario, 2004-2029. Accessed December 19, 2018.

7 EnerGuide Audits

EnerGuide audits were completed on 24 Quatsino homes. These audits were completed by Darrell Eason, a Certified Energy Advisor from Focused Energy Assessments. The purpose is to assess the energy efficiency of each participating home in the community. Each report includes a personalized *Energy Efficiency Action Roadmap.* This provides a thorough, comprehensive list of recommended upgrades for each participating home. Each of these recommendations is prioritized to allow residents to focus on the upgrades that will provide the greatest immediate energy savings for the household. Recommended upgrades detail the recommended renovations, financial considerations, and potential energy savings.

Implementing EnerGuide recommendations could save between 4,167 and 19,444 kWh/year per home, with an average household saving of 10,072 kWh/year. The average financial savings varies between $368 to $2,578 depending on tier rate.

5.1 Health and Safety Considerations

Health and safety considerations are summarized below. Individual EnerGuide assessments should be reviewed for additional details. Residences identified for each concern is identified in the supporting Data Summary at the end of this report.

- Mould was present in 9 participating homes (41%)
- Vermiculate, with the potential to obtain asbestos was identified in 1 home (5%)
- Combustion fume risks were identified in 3 participating homes (14%)
- Air quality issues due to a very airtight home without proper ventilation was identified in 4 homes (18%)
- Ventilation was inadequate in 12 homes (55%)

The following is recommended to address these health and safety concerns:

- Programmable/automatic bathroom fan controls and humidistat controls should be installed to remove moisture and prevent mould
- Rangehoods, bathroom fans, and HRV systems should be inspected and maintained for proper ventilation
- Residents should be reminded about the importance of using fans and rangehoods and how to address mould issues when they arise
- Fireplaces should be inspected on an annual basis; carbon monoxide detectors should be installed in all homes

5.2 How Energy Is Being Used

As shown in Figure 13, EnerGuide audits identified how the average Quatsino home consumes electricity. These results indicate that focusing on the average heating may be valuable as heating accounts for 47% of consumed electricity. This is less than the 2016 provincial average of 50%, likely due to the majority of homes (59%) using woodstoves and electricity for heating as indicated by the community in the September 2018 survey.[18]

Focusing further on heating, the EnerGuide audit calculates where homes lose heat (Figure 14). This information helps to identify what improvements may be the most effective in reducing heating costs.

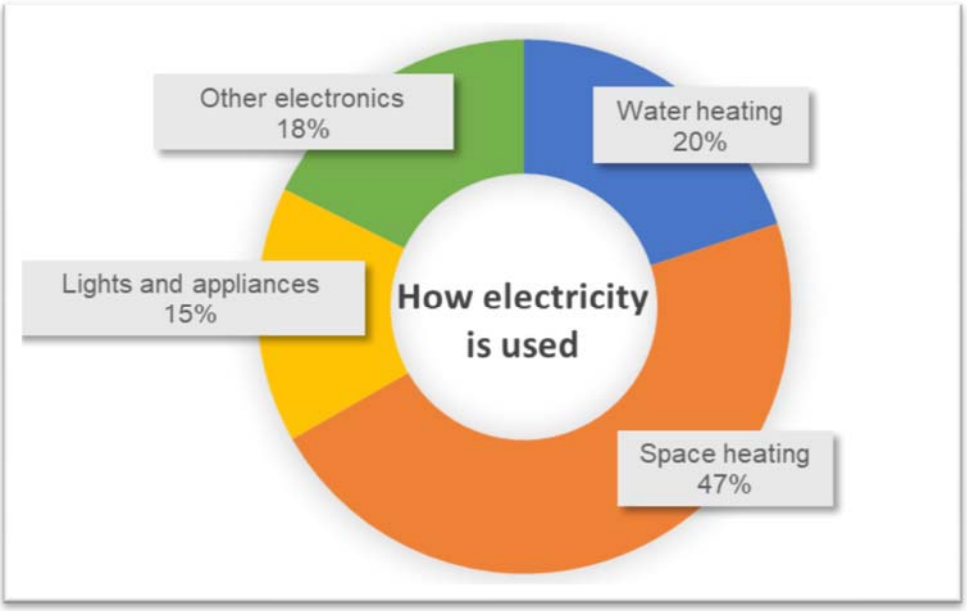


Figure 13: How energy is consumed in Quatsino homes

Natural Resources Canada. 2016. British Columbia Residential Sector: Secondary Energy Use and GHG Emissions by End-Use. Accessed January 2019.

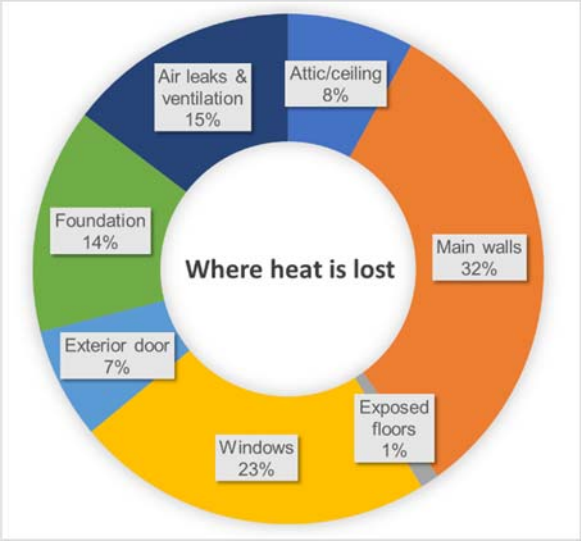


Figure 14: Where Quatsino homes lose heat

5.3 EnerGuide Recommendations

EnerGuide recommendations are summarized in Table 8 including the percentage of homes that each recommendation is relevant to and the estimated average annual cost savings after implementation.

Table 8: Summary of EnerGuide Audit Recommendations

Air Sealing	Upgrade Heating System	Upgrade Ventilation System	Replace Windows and/or Doors
			
100% of homes	**91% of homes**	**59% of homes**	**95% of homes**
Sealing cracks around windows, cracks, outlets, vents, etc.	Installation and use of heat pump as primary heat source	Upgrades to fans, HRVS, etc. **This is a health concern and should be a priority.**	Replace windows and doors with energy efficient options; properly align doors
Save $42/year per home	Save $1,109/year per home	*Costs* $33/year per home	Save $175/year per home

Insulate Foundation	Insulate Attic	Insulate Exposed Floors	Insulate Main Walls
			
89% of homes	**55% of homes**	**45% of homes**	**45% of homes**
Improve insulation of foundation/crawlspace	Improve attic insulation	Insulate exposed floors including basements/garages	Improve insulation of main walls for greater comfort
Save $120/year per home	Save $105/year per home	Save $52/year per home	Save $648/year per home

Savings assume Tier 2 rates ($0.1326/kWh)

5.3.1 Air Leakage Considerations

Air changes per hour (ACH) is a measure of “leakiness”. Houses that are too leaky are drafty, colder, and cost more to keep warm. Air-sealing is often recommended as the first step in increasing the energy efficiency in a home due to the relatively low cost and far-reaching benefits.

However, houses that don’t have enough air changes per hour are susceptible to air quality issue (eg. mould). These “air-tight” homes should carefully maintain their ventilation system (see 5.3.3).

On average, Quatsino homes are quite leaky with 5.2 ACH, 60% more than the average of 3.25 ACH for new BC homes. As a result, homes can be drafty and expensive to heat in winter. The EnerGuide recommendations identify opportunities for air-sealing. This includes: sealing around windows, re-aligning doors, insulating attic hatches and repairing drywall.

5.3.2 Heating System Energy Savings

Details of the recommended heating systems and potential savings are summarized in the appendix. Heat pump installations would save between $442 and $2,470 annually for each residence. In addition, heat pumps provide cooling in the summer and would further reduce electricity costs for homes that use seasonal air conditioning units. Due to the large number of houses that would benefit from heating system upgrades and the significant financial benefits possible, it is highly recommended that heat pump installation be pursued. In addition, the energy auditor recommends the installation of programmable thermostats to control baseboard heaters.

5.3.3 Ventilation System Upgrades

Recommended ventilation system upgrades include the maintenance, installation, or replacement of bathroom fans, kitchen rangehoods, and heat-recovery ventilation (HRV) systems. Additionally, the installation of automatic humidistats would ensure these systems are used when needed without relying on behavioural changes of all occupants. Education residences about how their ventilation system works and the importance of using ventilation is highly encouraged.

5.3.4 Window and Door Replacements

EnerGuide audits indicated that 30% of heat within homes is lost through windows and exterior doors. On average, upgrades would save 1,320 kWh/year, and approximately $175. Windows and door replacement can also substantially increase the comfort of homes by decreasing drafts and air movements. New installations will minimize condensation which will help prevent some mould occurrences. Additionally, doors shift throughout the season and all homes would benefit from professional realignment of existing doors by a qualified contractor

5.3.5 Insulation Upgrades: Foundations, Attics, Exposed Floors and Main Floors

Insulation upgrades were recommended in 89% of foundations/crawlspaces and 55% of attics. There are many considerations prior to upgrading insulation. It is recommended that relevant sections are reviewed in Natural Resources Canada's report *Keeping the Heat In* prior to initiating insulation upgrades. For example, main floor insulation upgrades can be very invasive and are best timed with exterior siding replacement.

5.3.6 Hot Water System Upgrades

Hot water systems should be upgraded with the energy efficiency option at the end of their functional life. While more expensive initially, energy efficiency units can save considerable money over the lifetime of the product. Hot water pipe insulation and hot water tank blankets are a low-cost option to reduce heat loss from the hot water system and is recommended.

8 Commercial Energy Audits

Analysis of 12 months of energy bills for the 4 commercial buildings indicates how energy is being used and the total cost to the Nation (Figure 15 and Figure 16). As detailed, the majority of consumption is energy used for heat (51%). The total annual cost to the Nation is $46,084. For a more detailed table of the energy consumption of each building see the appendices.

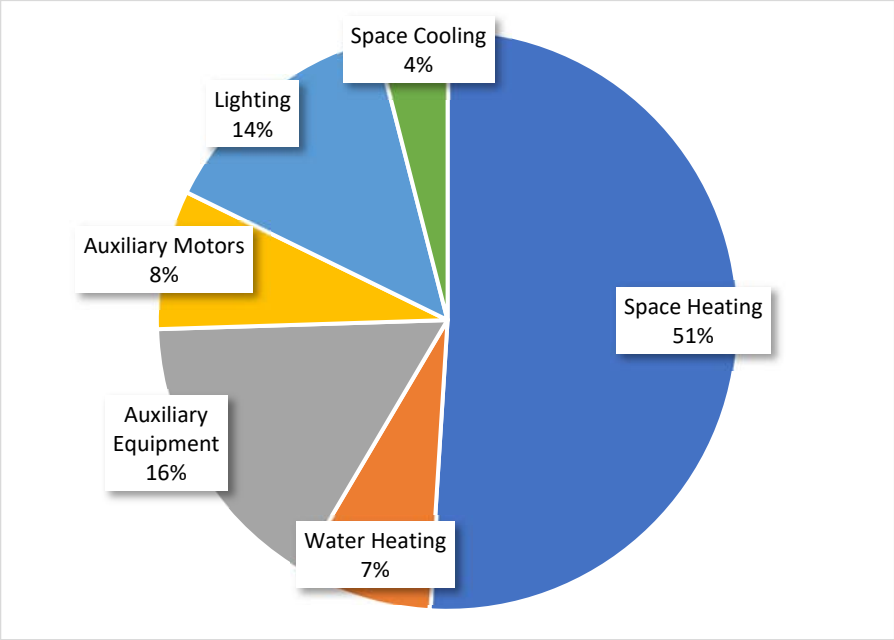


Figure 15: Commercial Energy Usage

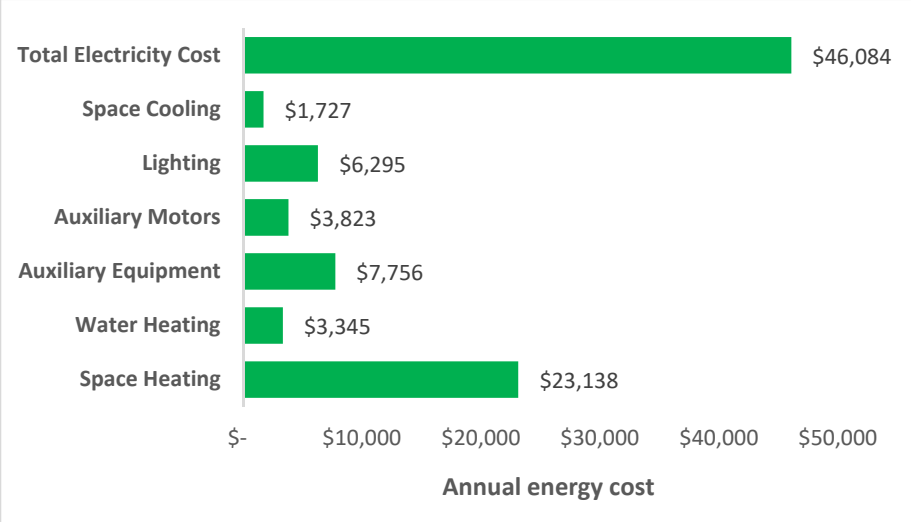


Figure 16: Commercial Electricity Costs

During the EnerGuide audit process, QFN had 4 commercial buildings assessed; the health centre, school, daycare, and community hall. The review of each of these commercial buildings identifies current energy use patterns and recommended upgrades to increase energy efficiency and comfort while decreasing operating costs.

5.1 Health Centre

The Health Centre was built in 2004 and at the time of the audit operated at 75% occupancy. Current annual consumption of the facility is 58,607 kWh. The ASHRAE Level 2 audit identified several recommended upgrades, installations and repairs as summarized in Table 9.

Table 9: Energy Efficiency Recommendations for Quatsino Health Centre

Recommendation	**Estimated savings** ($/yr)
Replace two boiler tanks with a heat pump hot water tank; existing units are past end of life period and new system would have double the efficiency	$253
Ensure that the water temperature is set to at least 120˚F	Safety issue
Install mini ductless heat pump; install programmable thermostats if heat pump installation delayed	$1,651 (heat pump)
Upgrade fluorescent lighting to LED	$864
Increase shade and prevent heat gain by planting deciduous trees on south side of building	Not specified
Replace commercial steel doors with medium density foam filled doors	Not specified
Continue to change air filters for ERV system every 1-3 months to maintain air quality	Not specified
Implement purchase policy that ensures new appliances are EnergyStar or energy efficient models and enforce “turn-off” schedule for computers, etc.	Variable
Access applicable BC Hydro rebates	Variable

5.2 Community Hall

The Community Hall is over 30 years old and is a long-standing community hub. Previously the space had been used as the main administration buildings; it’s future focus is currently under discussion. This building has a high energy consumption at 146,760 kWh/year. The ASHRAE Level 2 audit identified several recommended upgrades, installations and repairs as summarized in Table 10.

Table 10: Recommendations to Improve Energy Efficiency of Quatsino Community Hall

Recommendation	**Estimated savings** ($/yr)
Install central heat pump system	$3,920
LED lighting retrofit	$1,225
At end of life, replace electrical hot water tank with heat pump hot water tank	$492
Replace windows with EnergyStar, highly tinted models for climate zone 2	Not specified
Improve wall insulation, ideally with spray foam. Current insulation is minimal leading to high costs for heating	Not specified
Implement purchase policy that ensures new appliances are EnergyStar or energy efficient models	Variable
Consider solar PV [completed- determined not viable due to roof configurations and shading]	Not specified
Access applicable BC Hydro rebates	Variable

5.3 K’ak’olats’I School

K’ak’olats’I School as built in 2002 and is the building with the highest consumption in the Quatsino community at 174,400 kWh per year. In addition to high energy consumption, there are concerns that contractors are not always available to complete necessary maintenance and the lighting is on a timer that is not user friendly. There are also many system components that are at or nearing the end of their life and will require replacement. The ASHRAE Level 2 audit identified several recommended upgrades as summarized in

Table 11.

Table 11: Energy Efficiency Recommendations for K'ak'otlats'i School

Recommendation	Estimated savings ($/yr)
Replace electrical hot water tank with heat pump hot water tank	$627
LED lighting retrofit (currently a variety of types include metal halide, halogen, fluorescent, etc.)	$2,125
Install heat pump system with CO_2 sensors in air handling units for air quality and occupancy control	$4,010
Address lighting programming issues as control system has very high potential if operated properly for actual use	Not specified
Replace south-side/junior area windows with EnergyStar, highly tinted models or those with "HeatMirror" technology	Not specified
Replace commercial steel doors with medium density foam filled doors	Not specified
Add a continuous layer of rigid foam wall insulation if exterior siding is replaced to eliminate thermal bridges caused by studs	Not specified
Implement purchase policy that ensures new appliances are EnergyStar or energy efficient models	Variable

5.4 Daycare

The daycare was built in 2017 and performs quite well from an energy perspective, currently consuming 60,780 kWh/year. Recommendations resulting from the ASHRAE Level 2 audit are summarized in

Table 12.

Table 12: Energy Efficiency Recommendations for Quatsino Daycare

Recommendation	**Estimated savings** ($/yr)
Consider switching from Residential Conservation Rate (RCR) to the Small General Service (SGS) rate; this will result in savings if the energy consumption stays the same or increases but may result in losses if energy consumption decreases	~$300 based on current consumption
Ensure that all mechanical system defaults or settings are appropriate for actual use of building by discussing with occupants and adjusting as necessary	Not specified
In the long-term, replace the conventional electric hot water tank with a heat pump system	$297
Blow-in insulation in the attic to add R20-30	Not specified
Plant deciduous trees on the south side of the building to provide shade	Not specified
Install solar PV if financially viable	Not specified

9 Energy Conservation Assistance Program

In June 2018, 11 homes participated in the Energy Conservation Assistance Program (ECAP). This is a partnership program between BC Hydro and Fortis BC and is implemented by Its On Electric. There were several criteria that houses had to meet to be eligible for participation including occupant support, income limits, and elapsed time since previous participation.

Highlights of ECAP participation:

11 hot water tank pipes insulated

153 LED lightbulbs installed

10 Draft-proofing & weather-stripping

10 Carbon monoxide detectors installed

21 Low-flow tap and showerheads installed

Estimated Annual Savings				
418 kWh **$55**	**7,038 kWh** **$933**	**630 kWh** **$84**	**0 kWh** **N/A**	**9,849 kWh** **$1,306**

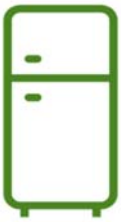
In addition to the energy efficient installations summarized above, the ECAP program provided behavioural recommendations for reducing electricity consumption and saving on electricity bills. These are applicable to all homes in the community.

Behavioural recommendations:

Turn down thermostat

Turn off lights & unplug electronics

Wash clothes in cold water



Set fridge to 2-4°C

Estimated Annual Savings
(based on BC Hydro estimates and additional assumptions)

1,306 kWh	**490 kWh**	**158 kWh**	**202 kWh**
$173	**$65**	**$21**	**$27**

10 Energy Efficiency Recommendations

The following is a summary of the recommendations and a timeline to be used as a guideline for implementation. The recommendations are based on importance, capital cost, cost-savings, and logistics of installation.

Short Term

- **Address safety concerns, including:**
  - Maintenance of HRVs to address ventilation safety concerns
  - Replace manual bathroom fan controls with automatic/programmable humidistats to address ventilation safety concerns
  - Ensure all homes have operational rangehoods
  - Educate residences on how mechanical systems work and importance of proper operation
  - Install carbon monoxide detectors and fire alarms in all homes
  - Remediate mould problem and mitigate with proper ventilation and heating
- Install heat pumps in all homes to increase the efficiency of the heating/cooling systems
- Insulate hot water tanks (2014 and older) with a tank wrap (RSI 1.7)
- Complete air-sealing including replacing attic hatches as needed, or adding a foam gasket
- Install digital, programmable thermostats (For both residential homes and commercial buildings)
- Door alignment/finishing should be completed by a qualified contractor that will assess whether reframing, sealing, or replacement are necessary
- Install LED Lighting for the Community Hall and Community School buildings.
- Amend Daycare building's billing structure from residential to commercial to avoid two-tier rate structure.

Medium Term

- Replace windows (including the window trim)
- Install heat pump hot water tanks in the Health Centre and Community School, and heat pumps in the Community Hall building and Health Centre.

Long Term/Ongoing

- Install a hot water system with an energy efficient model when the current system reaches the end of its operational life.
- Choose energy efficient products when replacing all appliances, lightbulbs, etc.
- Insulate building envelope when opportune due to other activities such as re-siding
- Provide seasonal reminders to community members and an ongoing energy efficiency education program
- Train local members to complete energy efficiency upgrades and retrofits

Table 13: Residential energy efficiency recommendations

Upgrade	% of Homes Recommended Upgrade	Estimated Unit Cost	Average Annual Savings[19]	Average Payback Period (yrs)	Details	Community Support
Upgrade Ventilation System[20]	59 %	Various	(-$33)	N/A	Air quality and health issue- high priority	94%
Air Sealing	100 %	$200/unit	$42	4.3	Homeowner could complete for less cost	76%
Upgrade Heating System	100 %	$6,500/unit	$1,109	9.4	Likely greatest impact for comfort and savings	61%
Upgrade Doors	95 %	$650/door	$175	4.8	Upgrade door and frame by professional contractor	94%
Upgrade Windows	95 %	$800/window	$175	66.7	By professional contractor	94%
Insulate Foundation	89 %	$1,447/home	$182	10.4	By professional contractor	89%
Insulate Attics	55 %	$3/sq. foot	$95	16.1	Assuming an attic area of 1,000 ft^2	89%

[19] Average annual savings based on kWh at current BC Hydro Tier 2 rates ($0.1326/kWh)
[20] Upgrades to ventilation system should be prioritized regardless of payback period.

11 Renewable Energy Generation Opportunities

Renewable energy generation opportunities considered in support of the Community Energy Plan included solar, wind, wave, and hydropower. An overview of these assessments is provided below and detailed reports are in the appendices. The results of all assessments are also provided in an interactive web map application. The web map application can be accessed through the Nation's online ArcGIS subscription.

5.1 Solar Photovoltaic Pre-Feasibility Assessment

A preliminary analysis of solar photovoltaic (PV) electricity generation potential focused on Quatsino community buildings. Grid-connected, rooftop-mounted facilities were considered for the community hall, K'ak'otlats'i School and health centre by Hakai Energy Solutions. Preliminary assessment eliminated the health centre due to unfavourable shading conditions and obstacles.

The capacity of the solar PV systems was identified based on available and favourable roof space and dimensions of the selected modules. The southern portion of the community hall was selected for further analysis, as was three roof sections of the school based on favourable conditions (see Figure 17 and Figure 18).

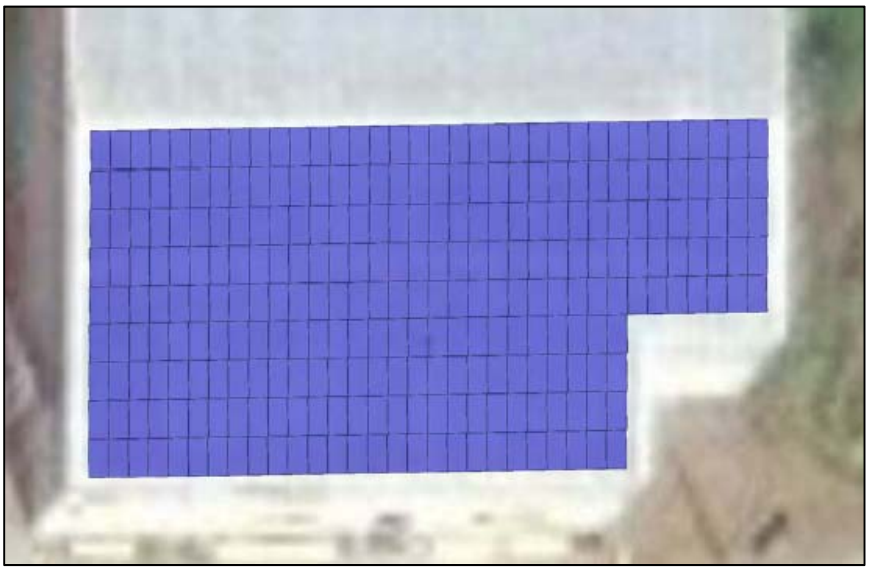


Figure 17: High-level design for community building

Figure 18: High-level design for K'ak'otlats'i School

The results of this feasibility assessment are summarized below in Table 14.

Table 14: Summary of solar photovoltaic feasibility assessment

	Community Hall	**K'ak'otlats'i School**
Capacity (kW)	105.6	125
PV modules	278 x REC Solar 380 W	329 x REC Solar 380 W
Inverters	2 x SMA CORE 1	2 x SMA CORE 1
Racking system	Kinetic Fast Rack	Unirac
System monitoring included?	Yes	Yes
Energy production- Year 1 (kWh/year)	100,035	110,078
Annual savings- Year 1 ($/year)	$9,683	$10,656
Installed cost ($)	$211,200	$250,000
Simple payback period (years)	17.1 years	19.4 years

The estimated project payback period is calculated using a simplified equation:

$$Payback\ period\ (yrs) = \frac{\sum(Annual\ generation\ (kWh)) * Cost\ of\ electricity\ (\frac{\$}{kWh})}{Cost\ of\ system\ supply\ and\ install\ (\$)}$$

Assumptions for this calculation include:

- Cost of electricity in Year 1 is based on the current BC Hydro Medium General Service rate of $0.0968/kWh
    - Rates increase at 3.5% annually[21]
- The modules perform at 97.5% estimated annual generation in Year 1 and degrade by 0.5% annually as per manufacturer warranty specifications
- The annual generation of the system is based on Helioscope software modelling considering module size, system specifications, slope and azimuth of roof, and insolation at project location based on ground and satellite data
- Inflation and discount rates were not considered
- Degradation of other components was not considered (eg. inverter)
- Annual maintenance costs are negligible as per cost estimate provided

Component warranties include a 25-year linear power warranty on the modules and 25-year manufacturer's warranty on the mounting system and 10-year inverter warranty. It is assumed for simple payback calculations that the inverter will last the lifetime of the project (25 years).

If QFN decides that this project is of interest, a solar installation professional should perform a site visit to confirm that buildings have the electrical equipment required to support a 100 kW feeder and revise cost estimates based on ground-truthing. Potential funding sources are identified in Section 12 that could be used to support solar PV development.

It is recommended that Quatsino First Nation secures funding to install solar on the Community Hall. After on year of installation the generation data should be reviewed and compared to estimates. The community survey showed 84% of members support a solar installation on one or more community buildings.

[21] The first five years of the 10-Year Rates Plan has seen average annual rate increases of 5.1% (Fiscal 2015 to Fiscal 2019). Accessed January 2019.

5.2 Wind Resource Assessment

In 2018, SRM Projects Ltd. completed a high-level wind energy screening study for the Quatsino First Nation (QFN) traditional territory in order to identify locations that may be suitable for commercial wind energy development. Several potential wind commercial energy sites within QFN territory were identified. The most promising areas identified are shown in Figure 19 and include: [22]

1. Knob Hill Area (partly developed already);
2. North of William Lake;
3. Power NE3/NW3 Peak Area;
4. Wady Peak Area;
5. Holberg/Mount Brandes Area

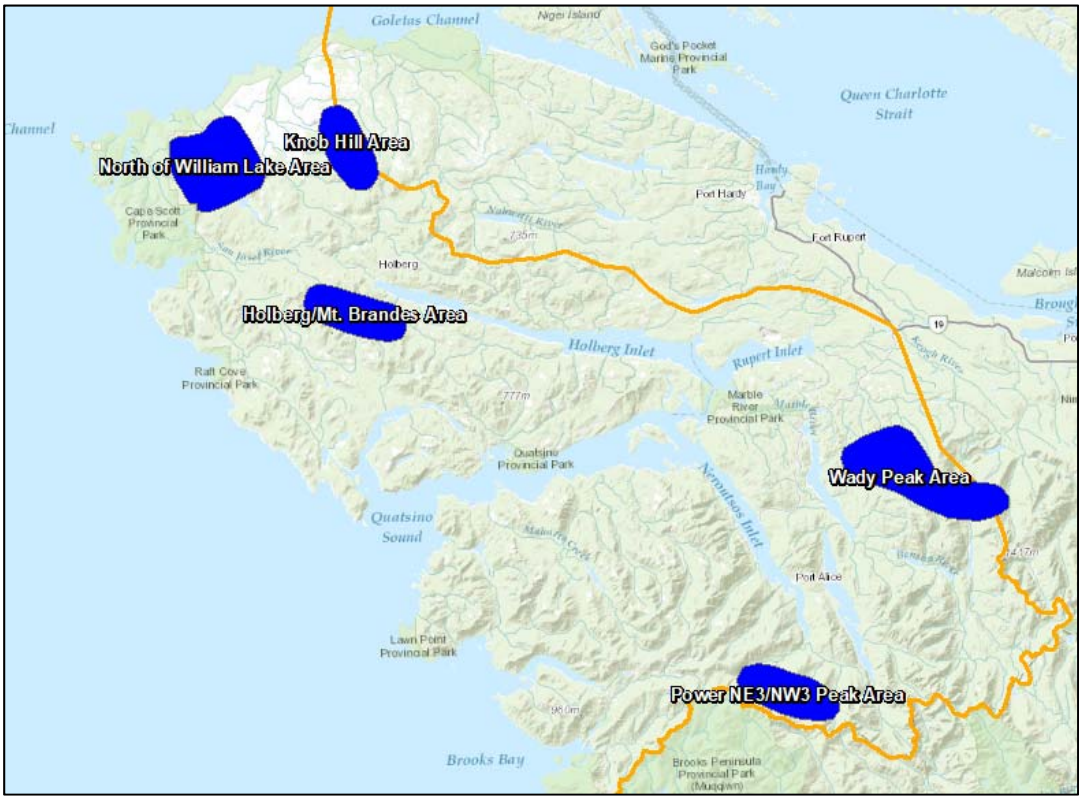


Figure 19: Areas of high commercial wind energy potential

[22] SRM Projects. November 2018. Quatsino First Nation Wind Energy Screening Study- Rev 0. Page 6

The study noted that if wind energy sites were developed in stages and clustered together there is potential to generate enough power to justify developing wind resource sites that are currently a long distance from the BC Hydro transmission grid. It was also determined that several QFN reserve lands are located within or close to areas of significant wind resources and therefore there is potential to harness wind energy for off-grid reserve lands.

The next step for wind development would be the completion of one or more site-specific feasibility studies. 70% of QFN members support the completion of detailed feasibility studies.

5.3 Wave Resource Assessment

The Pacific Regional Institute for Marine Energy Discovery (PRIMED) at the University of Victoria has carried out a wave resource assessment for the West Coast of Vancouver Island, within the Quatsino First Nation traditional territory. PRIMED used a model called Simulating WAves Nearshore (SWAN); data from two Environment Canada wave measure buoys (East Dellwood and South Brooks) was used to validate the model.

A final study point (50°30'9.846"N, 128°14'6.9396"W) off the Quatsino coastline was selected based on the following parameters:

- Wave energy using SWAN model results
- A water depth of 20 m to 40 m to reflect the needs of wave energy converters

A suitability map that considered wave resources, marine conservation areas, marine traffic density and commercial fishery value (see

- **Figure 20**).

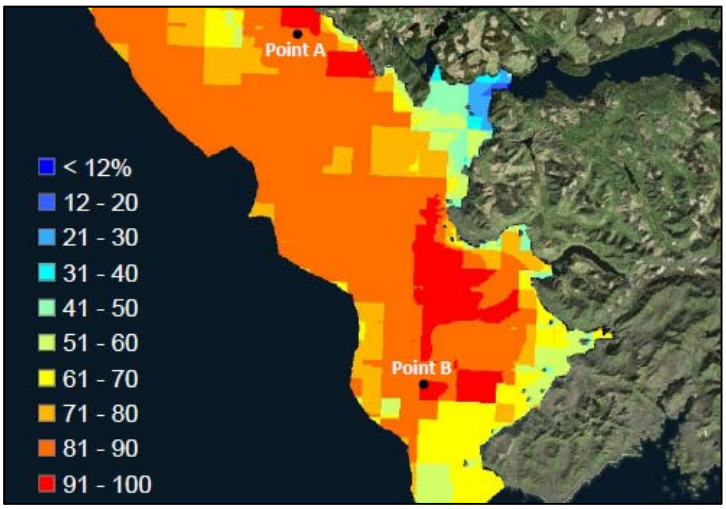


Figure 20: Suitability map and study point (Point A) selected for wave assessment[23]

[23] PRIMED. December 2018. Wave Resource Assessment of the Quatsino Traditional Territory.

Of two potential study points identified in

Figure **20**, Point A was selected as it is a shorter distance from the Quatsino community and therefore less expensive to connect to the electricity grid. Study point A has a 31.4 kW/m mean wave power, a depth of 41 m and a suitability score of 89%.

The potential power generation for a 10 m WEC at Point A was estimated using system efficiencies consistent with scientific literature. Potential power generation at various efficiencies is summarized in Table 15.

Table 15: Potential power generation for a 10 m WEC at various efficiencies, based on scientific literature[24]

	WEC Efficiency		
	3.1%	**11%**	**20%**
Annual (31.4 kW/m)	4.9 (kW)	17.3 (kW)	31.4 (kW)
Summer Months (9.55 kW/m)	1.48 (kW)	5.25 (kW)	9.55 (kW)
Winter Months (42.5 kW/m)	6.59 (kW)	23.4 (kW)	42.5 (kW)
Total yearly energy production	42.9 (MWhr/yr)	151 (MWhr/yr)	275 (MWhr/yr)

Presently, wave energy generation cannot be implemented as an economically viable technology compared to other generation options. However, there is enormous potential for wave energy, particularly off the coast of British Columbia. If Quatsino First Nation is interested in collaborating with technology developers and education institutions to deploy a demonstration project there is currently high potential for collaboration. The next steps to support this pursuit would be to develop a multi-disciplinary team and identify funding opportunities that would allow for a proof of concept demonstration. 65% of Quatsino members are in support of further evaluating wave energy and developing a business case.

5.4 Hydropower Resource Assessment

A hydropower resource assessment of the Quatsino First Nation Traditional Territory was completed in collaboration between Fathom Scientific Ltd. (Fathom) and Barkley Project Group (BPG).

This assessment was a multi-step process:

1. Fathom ran the HydroRecon modelling software which identified 677 theoretical hydropower project locations based on parameters such as watershed size, topography, and hydrology data
2. BPG filtered potential hydropower locations based on screening criteria that included: economic viability, existing infrastructure, land use and environmental factors.

[24] Adapted from: PRIMED. December 2018. Wave Resource Assessment of the Quatsino Traditional Territory.

3. Six creeks were identified for further detailed analysis. These creeks included: Youghpan Creek, Unnamed Creek, Teeta Creek, Craft Creek, Raging River, Raging River #2 (Figure 21).
4. Further analysis was then completed by Fathom including a more detailed HydroRecon assessment, called a CatScan. This hydrology analysis used daily flow data and the components of the project (intake, penstock, powerhouse) were placed deliberately to maximize power generation and minimize capital cost. The technical feasibility of each project arrangement was also considered.
5. A high-level lifecycle cost estimate was completed by Fathom for all projects based on estimated capital costs, lifetime generation and lifetime revenue.

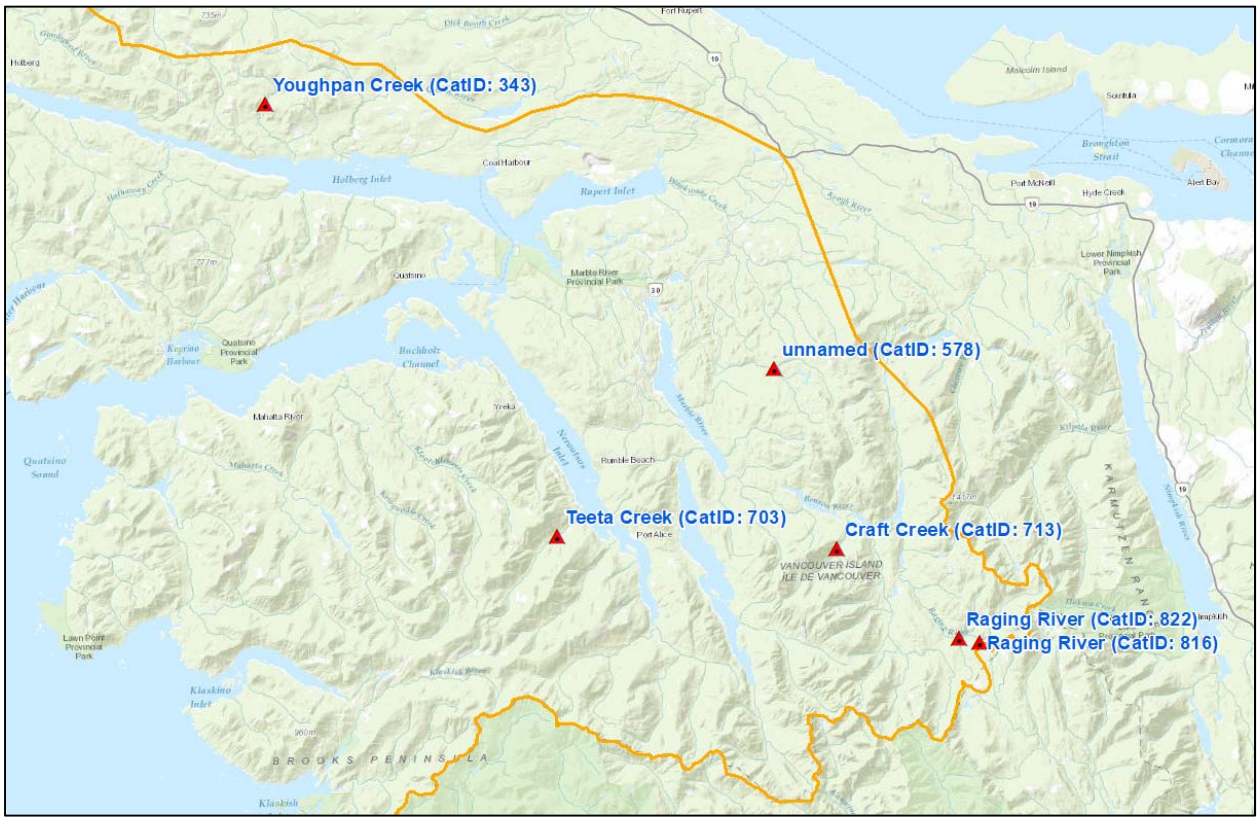


Figure 21: Locations of the top 6 creeks identified for detailed study.

The results of this study concluded that Unnamed Creek, Craft Creek and Raging River (CatID 816) are the most promising potential projects. The results of the analysis are summarized in Table 16.

Table 16: Select parameters of the top 3 conceptual hydropower projects

	Unnamed Creek	Craft Creek	Raging River
Cat ID	578	713	816
CatScan Option	B-1	B-1	B-1
Powerhouse Elevation (m)	194	120	343
Intake Elevation (m)	475	274	494
Head (m)	281	154	151
Drainage Area (km^2)	17.5	14.1	14.0
Penstock Length (m)	3565	2480	962
Penstock Diameter (m)	1.2	1.3	1.1
Mean Annual Discharge (m^3/s)	1.4	1.5	1.5
Design Flow (m^3/s)	2.5	2.6	2.6
Capacity (MW)	5.3	3.1	3.0
Annual Energy (GWH)	19	9	9
Cost ($Millions)	24	17	12
Net Present Value ($Millions)	3	-4	0
Levelized Cost of Energy ($ per MWH)	98	144	109

If QFN is interested in pursuing a hydropower project within their traditional territory, the next step would be to complete a focused business case for one or more of the identified projects. Ideally, this would include the implementation of a hydrometric program to collect site-specific data and corroborate modelling outputs. 63% of Quatsino members support investing in data gathering for future hydropower project development.

5.5 Renewable Energy Generation Recommendations

The following recommendations are contingent on interest from QFN to pursue the development of the identified renewable energy project.

SOLAR (84% community support)

1. Secure funding to complete the project installation on the community hall
2. Compare quotes from several contractors including site visit to confirm system size and electrical system compatibility
3. Complete system installation

4. (Long-term) Monitor the performance of installed system, expand if identified as community priority and supported by performance analysis

WIND (70% community support)

1. Secure funding to complete the following activities
2. Ground-truth the identified areas and investigate cultural and environmental significance of locations
3. Install a MET tower with an anonmeter to collect precise wind data
4. (Long-term) Analyze site-specific wind data and complete feasibility study/business case

WAVE (65% community support)

1. Form a multi-disciplinary team including WEC providers, academic and technical support, and Nation representatives
2. Secure funding for a feasibility study (Section 10)
3. (Long-term) Proceed with project development as funding and technology allows

HYDRO (63% community support)

1. Secure funding to complete the following activities
2. Complete a technical team site reconnaissance to ground-truth the results of the HydroRecon assessment
3. Implement a hydrometric program to confirm resource data
4. (Long-term) Analyse hydrometric data and complete feasibility study/business case

12 Greenhouse Gas Emissions Inventory

Greenhouse gas (GHG) emissions are gases that absorb and emit radiant energy causing atmospheric warming, known as the greenhouse effect. An excessive amount of GHG emissions in the atmosphere contributes to human-accelerated global warming. Communities have a responsibility in understanding how community activities cause GHG emissions.

Quatsino First Nation (QFN) has taken the initiative of performing a baseline GHG emissions inventory. The baseline inventory relies on limited data and high-level assumptions, incorporating both provincial and federal best practice recommendations. It is recommended that the GHG inventory be updated on an annual basis, and the baseline used to set future goals for the community.

12.1 Scope of GHG Emissions Inventory

As recommended by *BC Community Energy and Emissions Inventory (CEEI) Initiative,* three main sources of GHG emissions were considered: [25]

1. Direct emissions from burning fossil fuels;
2. Indirect emissions from electricity production; and,
3. Emissions from the decomposition of biomass in landfills

Unless otherwise stated, GHG emissions were quantified using the methods and recommendations of the British Columbia Ministry of Environment as presented the *2016/2017 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions.*[26]

12.2 Building Energy Consumption

Energy use in community buildings and homes contributes to overall GHG emissions. More specifically, figures from electricity use and heating (excluding wood-fired stoves) were assessed through the Energuide Audit process. The current estimate of electricity emissions factors provided by BC Hydro is shown in Table 17.

Table 17: Electricity Emission Factors – Purchased Electricity[27]

Public Utility	Emission Factor (tCO_2e/GWh)	Emission Factor ($kgCO_2e/GJ$)
BC Hydro	10.67	2.964

Housing Emissions

Home Energuide audits completed on 25 Quatsino homes include the current estimated GHG emissions and the potential GHG emissions possible if all recommendations for energy savings were implemented. A summary of current and potential GHG emissions is provided in Table 18. The average GHG emissions per home is 360 $kgCO_2e$ per year and the average potential reduction of GHG emissions is 156 $kgCO_2eq$ per home per year.

Table 18: Range of Energy Use Related GHG Emissions for Quatsino Houses

Range	Electricity Rate (GJ/yr)	Current GHG ($kgCO_2e$/yr)	Potential Rating (GJ/yr)	Potential GHG ($kgCO_2e$/yr)
Min	6	200	36	200
Avg	77	360	46	204
Max	116	500	55	300

Assuming the EnerGuide audit results are representative of home energy use overall, the total GHG emissions from home power and heating (excluding wood-fired stoves) is approximately 31.7 tCO_2e per year. The potential for GHG emissions reductions, if all EnerGuide recommendations are implemented is 13.7 tCO_2e per year.

Community Buildings Emissions

A summary of current GHG emissions and potential GHG emissions through implementation of ASHRAE Level 2 audit recommendations on community buildings is provided in

Table 19. The total current GHG emissions from the community buildings analyzed is estimated at 4.7 tCO_2e per year.

Table 19: Summary of Community Buildings Current & Potential GHG Emissions (annual basis)

Building	Annual Consumption (kWh/yr)	Current GHG (kg CO_2e/yr)	Potential Consumption (kWh/yr)	Potential GHG (kg CO_2e/yr)
Community Hall	146,760	1565.9	81,199	866.4
Day Care	60,780	648.5	58,536	624.6
Health Center	58,607	625.3	28,366	302.7
School	174,400	1860.8	89,371	953.6
TOTAL	**440,547**	**4,701**	**257,472**	**2,747**

Recommendations

Please refer to the recommendations for energy savings in homes and community buildings provided in the CEP report.

For the purpose of the community GHG inventory, it is assumed that the average annual road transportation emissions for Quatsino members are the same as the provincial averages. An approximate breakdown of community member owned vehicles and community fleet vehicles currently in operation is provided in Table 20. The community-owned fleet vehicles include: two school buses, one medical van, one youth van, one maintenance truck, and one fisheries truck. The vehicles and equipment owned by the logging company are outside the scope of the community GHG assessment.

Table 20: Summary of Quatsino Community Vehicles[28]

[28] Housing Manager, Quatsino First Nation. January 2019. *Quatsino CEP – GHG Inventory*. Phone Call – Number of Vehicles in Community; confirmed via email.

Vehicle Type	Number of Vehicles
Community Members Vehicles	
Light-duty gasoline truck	27
Light-duty gasoline car	49
Light-duty gasoline SUV / Jeep	12
Motorcycle	2
Community-Owned Equipment	
Heavy-duty Diesel Vehicles	2
Light-duty Gasoline Trucks	2
Light-duty Gasoline Vehicles	2

Total GHG emissions due to community road transportation is estimated to be 428.7 tCO_2e per year.

Recommendations

1. Carpooling: sharing car space during routine trips, such as a grocery run to Port Hardy, can be an effective way to save fuel and reduce overall GHG emissions
2. Public Transit: relying on public transit, which offers multiple trips from Quatsino to Port Hardy on a daily basis, is an effective means of reducing individual transportation emissions
3. Alternate Transportation Methods: utilizing alternate means of transportation, such as using a bicycle or walking to get around the village, is a simple way to reduce road transportation emissions
4. Switching to Fuel-Efficient Vehicles: If it is financially feasible to do so, when the time comes to replace a vehicle, consider switching to a more fuel-efficient vehicles to save money on fuel and reduce GHG emissions

12.3 Solid Waste

The GHG emissions created from community solid waste disposal have two main sources:

1) solid waste transport (truck hauling to 7-mile landfill); and,
2) landfill gas production from the decomposition of solid waste

Solid waste is picked up from a 30-yard community bin on a weekly basis by Fox Disposal Contracting and transported 40km for disposal in the Seven-Mile Landfill[29]. Waste

[29] Greg Fox, Fox Disposal Services Ltd., January 2019. Phone Conversation – Quatsino Waste Hauling Practices.

transport is completed using a standard roll-off garbage truck. An estimate of GHG emissions due to weekly solid waste transport are summarized in Table 21.

Table 21: Estimated Annual GHG Emissions due to QFN Solid Waste Transport

Vehicle Type	Emissions (kg/L)	Fuel Efficiency (L/100km)	Weekly Distance (km)	Weekly Emissions ($kgCO_2e$)	Annual Emissions (tCO_2e)
Heavy-duty diesel vehicle	2.63[30]	39.5[31]	40	41.55	2.16

Quatsino solid waste is hauled for long-term disposal in the Seven-Mile landfill; the annual tonnage sent to the landfill has been tracked since 2010, shown in the Table 22 below. It is worth noting that the annual waste amount is increasing quite consistently, and better waste management practices could be put in place.

Table 22: Quatsino Solid Waste Tonnage, 2010 to 2017[32]

Year	2010	2011	2012	2013	2014	2015	2016	2017
Waste (tonnes)	57.63	59.33	56.23	55.45	48.87	63.82	78.61	74.29

[30] BC Ministry of Environment. May 2016. *2016 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions.* Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2016-17-pso-methodology.pdf

[31] Natural Resources Canada. April 2016. *Fuel Efficiency Benchmarking in Canada's Trucking Industry.* Retrieved from: https://www.nrcan.gc.ca/energy/efficiency/transportation/commercial-vehicles/reports/7607

[32] Patrick Donaghy. Operations Manager, Regional District of Mount Waddington. November 19, 2018. *Email – RE: REDMW / BPG Questions – Action Items.*

A recent Landfill GHG Emissions report from the Seven-Mile Landfill estimated the total GHG emissions due to landfilled gas production 2017 were 310 tonnes CH_4/year (7,750 tCO_2e/year) corresponding with 7,421 tonnes of landfilled waste[33]. It is reasonable to assume the percentage of total landfill waste made up of by Quatsino solid waste is similar to the percentage of GHG emissions directly resulting from Quatsino solid waste[34]. The 74.29 tonnes of Quatsino waste hauled to the Seven-Mile Landfill in 2017 made up approximately 1% of total landfilled waste.

Therefore, the total estimated GHG emissions from solid waste transport and landfill disposal is 77.5 tCO_{2e}.

Recommendations

According to community poll results from a meeting in Quatsino in September 2018, 58% of respondents are recycling and 26% are composting. However, it is not certain if all recyclables are included, or if only paper products are currently being recycled. Ultimately, to decrease the amount of GHG emissions due to solid waste, QFN needs to divert more waste from going to the landfill. In order to do so, it is recommended to increase education on waste management best practices and move toward a Zero Waste Policy goal.

12.4 Quatsino GHG Emissions Summary

A summary of estimated current GHG emissions and potential quantities if all recommendations are implemented, across the three sectors in the GHG inventory scope (buildings road transportation and solid waste disposal), is provided in Table 23.

Table 23: Summary of Community GHG Emissions and Potential Reductions

GHG Emissions	Community Buildings	Houses	Road Transportation	Solid Waste	TOTAL
Current (tCO2e)	4.7	31.7	428.7	77.5	542.6
Potential (tCO2e) after reductions	2.7	18	385.8	69.7	476.3

The current GHG emissions for the Quatsino community are 542.6 tCO_{2e}/year. If all recommendations are followed, GHG emissions reduction potential in total is

[33] Sperling Hansen Associates. February 2019. *7-Mile Landfill – 2017 Annual Report.* Prepared for Regional District of Mount Waddington.
[34] Ali Abedini. Landfill Gas Specialist, Sperling Hansen Associates Inc. January 2019. *Phone Conversation – Land Gas Estimation Practices.*

approximately 66.3 t CO_2e. For perspective, this equates to GHG emissions from: 14.1 passenger vehicles annually, 2,893 bags of trash or 8,454,067 charges of a phone.

13 Funding Opportunities

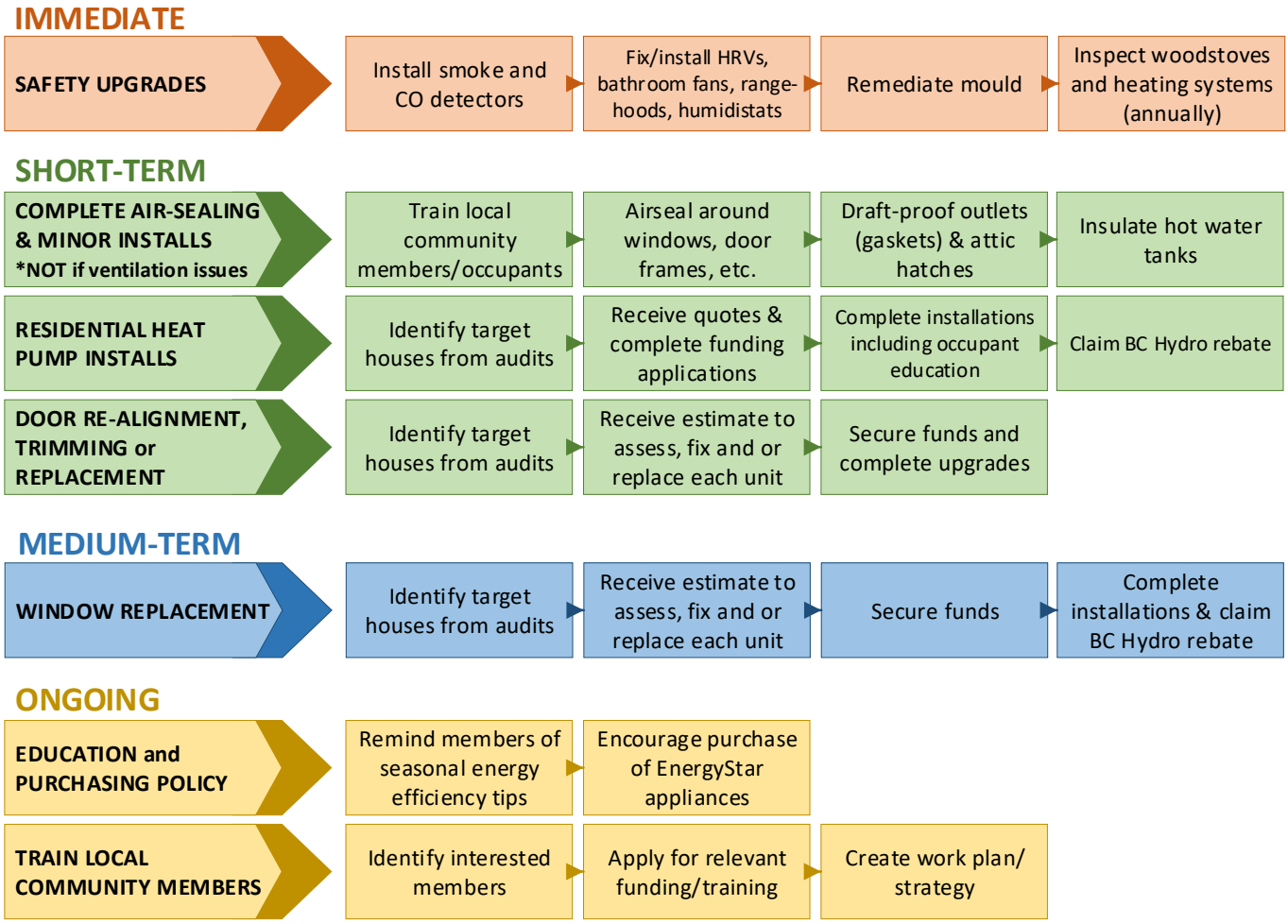
A variety of funding sources are available that support energy efficiency and renewable energy opportunities (see Table 24).

Table 24: Funding opportunities to support implementation of CEP

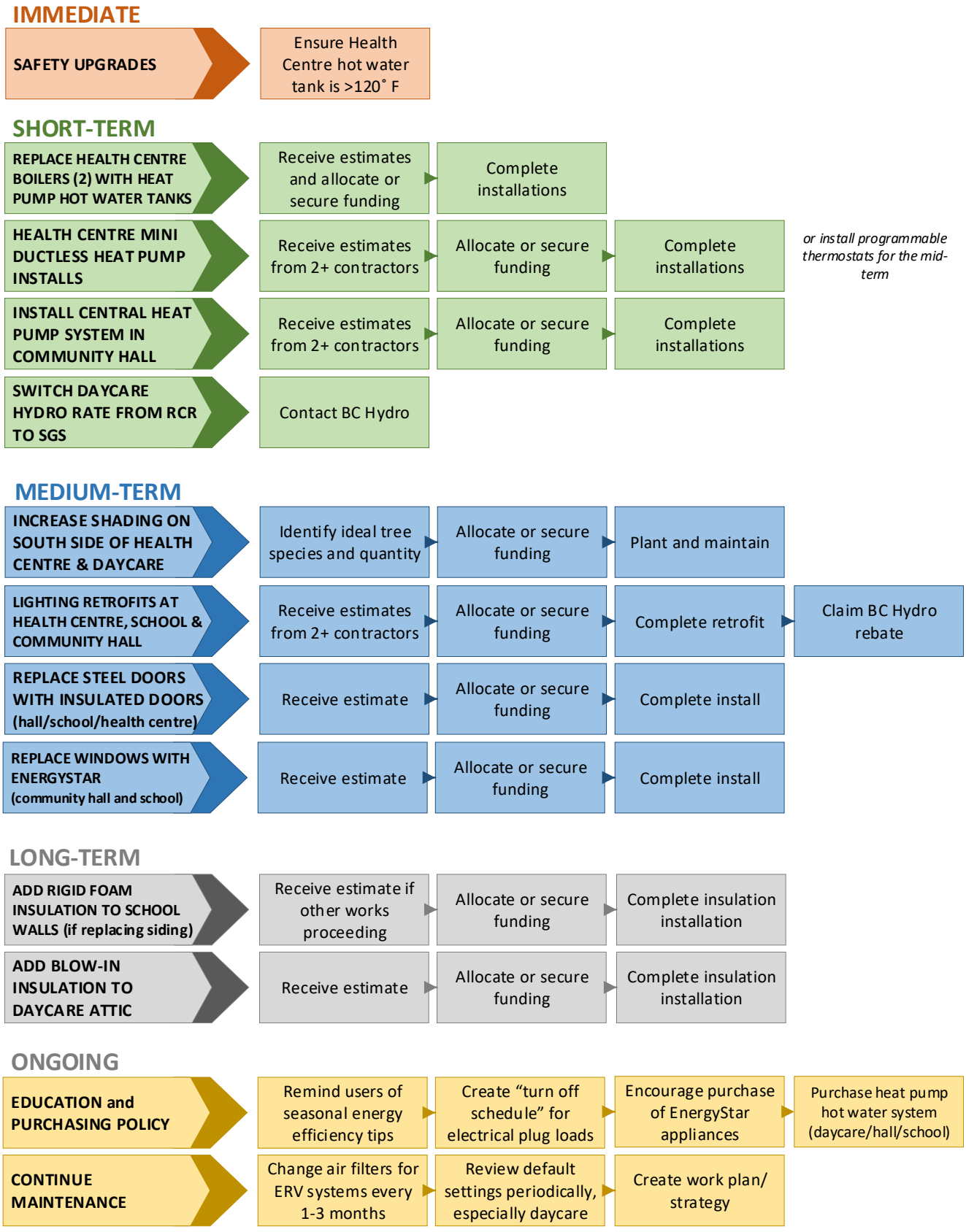
Fund / Program	Intake Deadline	Amount	Target
Clean Energy Business Fund (MIRR)	Jan & May	$50,000 capacity; $500,000 equity	CEPs, energy efficiency projects, renewable energy projects
ECAP Program	Ongoing	Various	Basic residential energy evaluation and product installation
Vancity Community Partnership Program	Ongoing	$10,000	Energy efficiency and renewable energy technologies
BC Indigenous Clean Energy Initiative (New Relationship Trust)	March	$150,000	Clean energy and energy efficiency initiatives
BC Hydro Energy-Saving Kits	Ongoing	Various	Basic energy efficiency products
BC Housing Skills Plus Program	Ongoing	Training	Building Maintenance workers and janitorial staff
Rural Dividend Fund	May & October	$10,000	Housing development strategies/ sustainability plans
TD Friends of the Environment Foundation	July	$8,000	Community outreach and environmental training
Real Estate Foundation of BC	February & September	Various	Housing upgrades, “built environment” sustainability
Island Coastal Economic Trust	Ongoing	$30,000 & $400,000	Support new and sustainable regional economic growth
Community Energy Leadership Program	May	$10,000 to $175,000	Energy efficiency and renewable energy
Community Opportunities Readiness Program (ISC)	Ongoing	Various	Support economic opportunities and leverage private sector
Capacity Initiative- New Relationship Trust	May	$25,000	To support capacity building

14 Implementation Plans

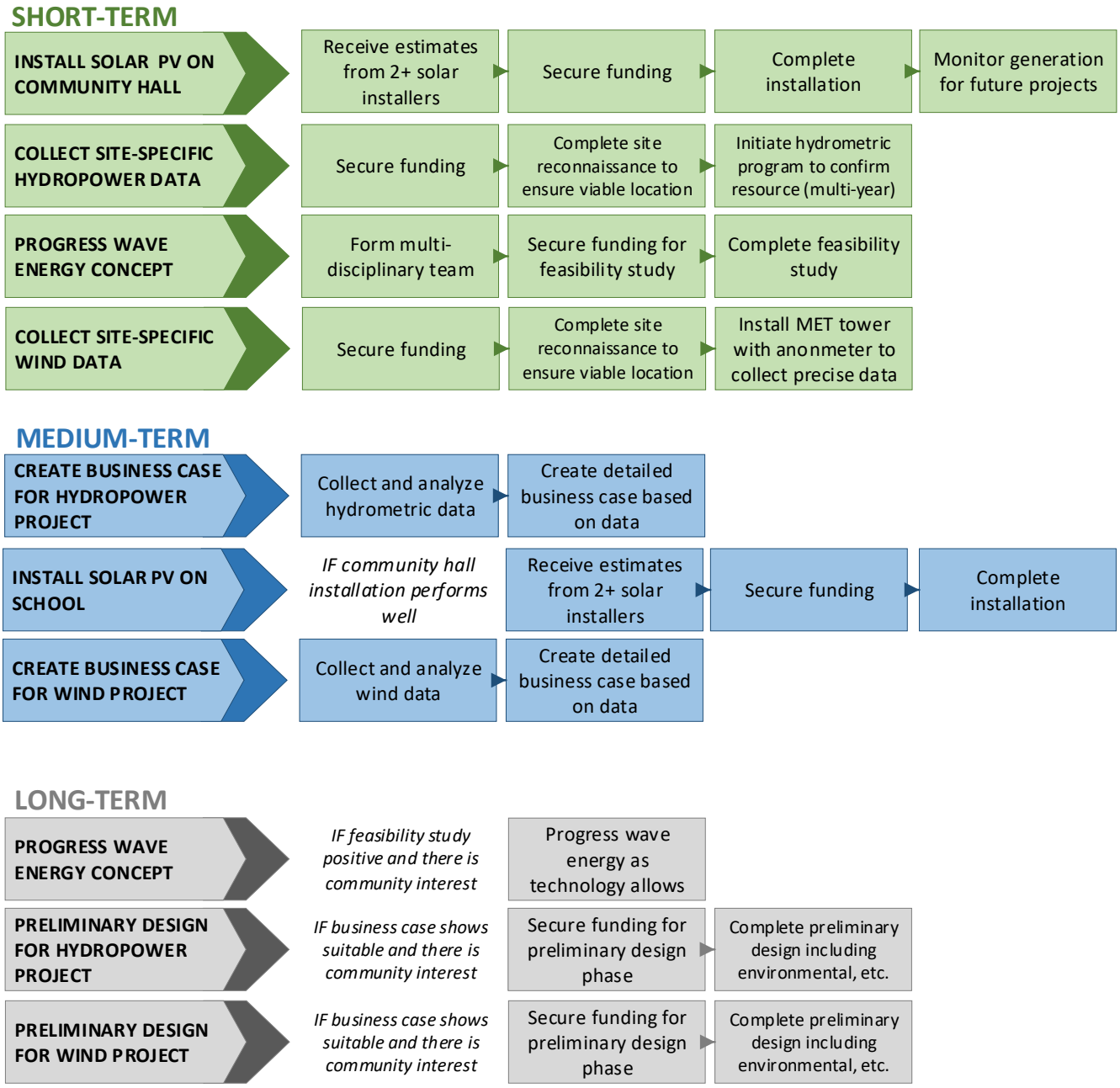
14.1 Residential Energy Efficiency Implementation Plan



14.2 Community Building Energy Efficiency Implementation Plan



14.3 Renewable Energy Implementation Plan



Summary of Data- Details of Audits

Summary A: Health and safety issues in assessed residences

Address	Health and Safety Issues				
	Vermiculate?	Air quality issue?	Combustion fume risk?	Mould?	Ventilation issue?
416 Kwatleo Rd					
307 Quattishe Rd				●	
500 Kwatleo Rd				●	
327 Quattishe Rd		●			
325 (Unit B) Quattishe Rd		●			
316 Quattishe Rd				●	●
331 Quattishe				●	●
412 Kwatleo Rd					
110 Teeta Rd			●	●	
105 Teeta Rd			●	●	●
209 Clienna Rd					●
318 Quattishe Rd					●
448 Quattishe Rd					●
315 Quattishe Rd				●	
217 Clienna Rd					●
212 Clienna Rd					
329 Quattishe Rd					●
312 Quattishe Rd			●		●
205 Clienna Rd	●	●		●	
337 Quattishe Rd					
203 Clienna Rd					●
322 Quatishe					●
335 Quattishe Rd		●			●
320 Quattishe Rd				●	

Summary B: Potential energy savings from air-sealing and draftproofing upgrades

Address	Current Air Leakage (ACH)	Potential Savings (GJ/year)	Potential Savings (kWh/year)	Potential Savings ($/year)	Installation Cost ($)	Simple Payback (Years)
416 Kwatleo Rd	3.83	1	278	36.86	$200	5.4
500 Kwatleo Rd	3.53	1	278	36.86	$200	5.4
327 Quattishe Rd	4.67	1	278	36.86	$200	5.4
316 Quattishe Rd	6.11	1	278	36.86	$200	5.4
331 Quattishe	6.18	2	556	73.73	$200	2.7
412 Kwatleo Rd	4.64	1	278	36.86	$200	5.4
110 Teeta Rd	5.21	2	556	73.73	$200	2.7
105 Teeta Rd	4.01	1	278	36.86	$200	5.4
209 Clienna Rd	5.72	1	278	36.86	$200	5.4
318 Quattishe Rd	6.25	2	556	73.73	$200	2.7
448 Quattishe Rd	3.48	1	278	36.86	$200	5.4
315 Quattishe Rd	8.96	-1	-278	-36.86	$200	-5.4
217 Clienna Rd	5.67	1	278	36.86	$200	5.4
212 Clienna Rd	5.38	1	278	36.86	$200	5.4
312 Quattishe Rd	3.2	1	278	36.86	$200	5.4
205 Clienna Rd	4.12	1	278	36.86	$200	5.4
337 Quattishe Rd	7.19	3	834	110.59	$200	1.8
203 Clienna Rd	4.85	1	278	36.86	$200	5.4
322 Quatishe	6.26	1	278	36.86	$200	5.4
335 Quattishe Rd	4.19	1	278	36.86	$200	5.4
320 Quattishe Rd	6.76	1	278	36.86	$200	5.4

Summary C: Potential energy savings from improving attic/ceiling insulation

Address	**Potential Savings** (GJ/year)	**Potential Savings** (kWh/year)	**Potential Savings** ($/year)	**Installation Cost** ($)	**Simple Payback** (Years)
416 Kwatleo Rd	4	1112	147.45	$1,124	7.6
500 Kwatleo Rd	2	556	73.73	$1,124	15.2
412 Kwatleo Rd	3	834	110.59	$1,124	10.2
209 Clienna Rd	2	556	73.73	$1,124	15.2
318 Quattishe Rd	2	556	73.73	$1,124	15.2
448 Quattishe Rd	2	556	73.73	$1,124	15.2
315 Quattishe Rd	6	1668	221.18	$1,124	5.1
212 Clienna Rd	2	556	73.73	$1,124	15.2
329 Quattishe Rd	1	278	36.86	$1,124	30.5
312 Quattishe Rd	1	278	36.86	$1,124	30.5
322 Quatishe	1	278	36.86	$1,124	30.5
335 Quattishe Rd	9	2502	331.77	$1,124	3.4
320 Quattishe Rd	2	556	73.73	$1,124	15.2

Summary D: Potential energy savings from basement or foundation insulation

Address	Potential Savings (GJ/year)	Potential Savings (kWh/year)	Potential Savings ($/year)	Installation Cost ($)	Simple Payback (Years)
307 Quattishe Rd	3	834	110.59	$1,447	13.1
327 Quattishe Rd	4	1112	147.45	$1,447	9.8
412 Kwatleo Rd	4	1112	147.45	$1,447	9.8
110 Teeta Rd	7	1946	258.04	$1,447	5.6
105 Teeta Rd	3	834	110.59	$1,447	13.1
209 Clienna Rd	4	1112	147.45	$1,447	9.8
318 Quattishe Rd	5	1390	184.31	$1,447	7.9
448 Quattishe Rd	4	1112	147.45	$1,447	9.8
315 Quattishe Rd	4	1112	147.45	$1,447	9.8
217 Clienna Rd	6	1668	221.18	$1,447	6.5
212 Clienna Rd	4	1112	147.45	$1,447	9.8
329 Quattishe Rd	3	834	110.59	$1,447	13.1
312 Quattishe Rd	6	1668	221.18	$1,447	6.5
205 Clienna Rd	6	1668	221.18	$1,447	6.5
337 Quattishe Rd	9	2502	331.77	$1,447	4.4
203 Clienna Rd	1	278	36.86	$1,447	39.3
322 Quatishe	10	2780	368.63	$1,447	3.9
335 Quattishe Rd	7	1946	258.04	$1,447	5.6
320 Quattishe Rd	3	834	110.59	$1,447	13.1

Summary E: Potential energy savings from main wall insulation

Address	**Potential Savings** (GJ/year)	**Potential Savings** (kWh/year)	**Potential Savings** ($/year)	**Installation Cost** ($)	**Simple Payback** (Years)
307 Quattishe Rd	6	1668	221.18	$2,054	9.3
327 Quattishe Rd	7	1946	258.04	$2,054	8.0
316 Quattishe Rd	13	3614	479.22	$2,054	4.3
331 Quattishe	24	6672	884.71	$2,054	2.3
318 Quattishe Rd	18	5004	663.53	$2,054	3.1
315 Quattishe Rd	7	1946	258.04	$2,054	8.0
212 Clienna Rd	19	5282	700.39	$2,054	2.9
337 Quattishe Rd	27	7506	995.30	$2,054	2.1
322 Quatishe	4	1112	147.45	$2,054	13.9
335 Quattishe Rd	51	14178	1880.00	$2,054	1.1

Summary F: Potential energy savings from window replacement

Address	**Quantity** (#)	**Potential Savings** (GJ/year)	**Potential Savings** (kWh/year)	**Potential Savings** ($/year)	**Installation Cost** ($) [$800/win]	**Simple Payback** (years)
416 Kwatleo Rd	14	7	1,946	$258	$11,200	43.4
500 Kwatleo Rd	19	4	1,112	$147	$15,200	103.1
316 Quattishe Rd	2	1	278	$37	$1,600	43.4
331 Quattishe	10	4	1,112	$147	$8,000	54.3
318 Quattishe Rd	11	2	556	$74	$8,800	119.4
212 Clienna Rd	13	5	1,390	$184	$10,400	56.4
337 Quattishe Rd	20	7	1,946	$258	$16,000	62.0
322 Quatishe	19	8	2,224	$295	$15,200	51.5

Summary G: Potential energy savings from heat pump installations

Address	Potential Savings (GJ/year)	Potential Savings (kWh/year)	Potential Savings ($/year)	Installation Cost ($)	Simple Payback
416 Kwatleo Rd	25	6,950	$ 922	$7,500	8.1
307 Quattishe Rd	11	3,058	$ 405	$7,500	18.5
500 Kwatleo Rd	35	9,730	$ 1,290	$7,500	5.8
316 Quattishe Rd	22	6,116	$ 811	$7,500	9.2
331 Quattishe	57	15,846	$ 2,101	$7,500	3.6
412 Kwatleo Rd	28	7,784	$ 1,032	$7,500	7.3
110 Teeta Rd	53	14,734	$ 1,954	$7,500	3.8
105 Teeta Rd	12	3,336	$ 442	$7,500	17.0
209 Clienna Rd	20	5,560	$ 737	$7,500	10.2
318 Quattishe Rd	29	8,062	$ 1,069	$7,500	7.0
315 Quattishe Rd	17	4,726	$ 627	$7,500	12.0
217 Clienna Rd	26	7,228	$ 958	$7,500	7.8
212 Clienna Rd	42	11,676	$ 1,548	$7,500	4.8
329 Quattishe Rd	16	4,448	$ 590	$7,500	12.7
312 Quattishe Rd	11	3,058	$ 405	$7,500	18.5
205 Clienna Rd	21	5,838	$ 774	$7,500	9.7
203 Clienna Rd	17	4,726	$ 627	$7,500	12.0
322 Quatishe	28	7,784	$ 1,032	$7,500	7.3
335 Quattishe Rd	65	18,070	$ 2,396	$7,500	3.1