

**BC HYDRO**  
**SUSTAINABLE ENERGY SOLUTIONS**

**ATLIN COMMUNITY ENERGY PLANNING**  
**ASSESSMENT OF SUPPLY OPTIONS**



Prepared for: **Aboriginal Relations Department, Generation and  
Power Planning and Portfolio Management, Distribution**

**BChydro**   
**ENGINEERING**

Report No. E268  
April 2004

---

**BC HYDRO**  
**SUSTAINABLE ENERGY SOLUTIONS**

**ATLIN COMMUNITY ENERGY PLANNING**  
**ASSESSMENT OF SUPPLY OPTIONS**

---

**BC HYDRO**  
**SUSTAINABLE ENERGY SOLUTIONS**

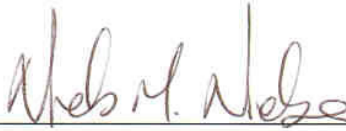
**ATLIN COMMUNITY ENERGY PLANNING**  
**ASSESSMENT OF SUPPLY OPTIONS**

Prepared by:



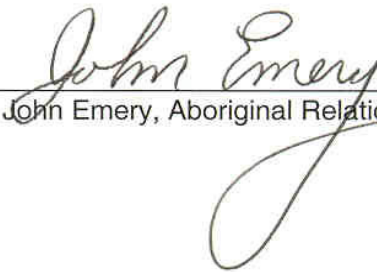
H. Hamilton Harding, EIT, Engineering

Reviewed by:



N.M. Nielsen, P.Eng., Engineering

Accepted by:



John Emery, Aboriginal Relations Department

## ACKNOWLEDGEMENTS

### **BC Hydro**

Sustainable Energy Solutions (SES), Engineering	H. Hamilton Harding, EIT	Project Manager
SES, Engineering	N.M. Nielsen, P.Eng.	Senior Review
SES, Engineering	John Croockewit, P.Eng.	Small Hydro Study
SES, Engineering	Glenn Erho	Wind Tower and Monitoring
SES, Engineering	Ryanne Metcalf, GIT	Wind Study
Aboriginal Relations Department	John Emery	Project Initiator
NIA	Randy North	Information
Field Services	Dan Gilgan	Information & Review
NIA	Pun Chu	Information & Review
NIA	David Carlson	Information & Review

### **Consultants**

Enerficiency Consulting	Michael Wilson, P.Eng	Energy Efficiency Study
PO Sjoman Hydrotech Consulting	Pentti Sjoman, P.Eng.	Small Hydro Study
Hydro Tasmania	Ray Massie	Wind Study

### **Atlin Community**

TRTFN	Peter Kirby	Capital Projects Manager
ATDC	Stuart Simpson	CEO

**BC HYDRO**  
**SUSTAINABLE ENERGY SOLUTIONS**  
  
**ATLIN COMMUNITY ENERGY PLANNING**  
**ASSESSMENT OF SUPPLY OPTIONS**

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
	DISCLAIMER.....	- iii -
	EXECUTIVE SUMMARY.....	- v -
1.0	INTRODUCTION.....	1 - 1
	1.1 Background.....	1 - 1
	1.2 Objectives.....	1 - 3
	1.3 Scope and Methodology.....	1 - 4
	Figure 1-1: Location Map	
2.0	COMMUNITY (EDUCATION, INFORMATION, CONSULTATION).....	2 - 1
	2.1 Education and Awareness.....	2 - 1
	2.2 Consultation.....	2 - 2
	2.3 Capacity Building.....	2 - 3
	Photo 2-1: Open House: Kids learning about energy efficiency, CEP team, question period, poster display	
3.0	ENERGY PROFILE.....	3 - 1
	3.1 Community Profile.....	3 - 1
	3.2 Demand Assessment.....	3 - 1
	3.3 Current Economics.....	3 - 4
	3.4 Community Survey.....	3 - 6
	Figure 3-1: Historical Monthly Peak Load	
	Figure 3-2: Historical Monthly Generation	
	Figure 3-3: Daily Load Profile (Jan 2002)	
	Figure 3-4: Peak Load and Energy Demand Forecast	

CONTENTS - Cont'd

<u>Section</u>	<u>Subject</u>	<u>Page</u>
3.0	ENERGY PROFILE - Cont'd	
	Table 3-1 Zone 2 Rate Structure	
	Table 3-2 Current Atlin DGS Unit Costs	
4.0	SUPPLY OPTIONS .....	4 - 1
4.1	Existing Diesel .....	4 - 2
4.2	Small Hydro .....	4 - 3
4.3	Wind.....	4 - 5
4.4	Connection to Yukon Grid.....	4 - 7
4.5	Option Comparison - Discussion .....	4 - 9
	Figure 4-1: Atlin Energy Resources	
	Photo 4-1: Transmission Line and right-of-way, Alaska Highway west of Jake's Corner	
	Table 4-1: Energy Supply Option Comparison	
5.0	ENERGY EFFICIENCY .....	5 - 1
6.0	DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS.....	6 - 1
6.1	Discussion .....	6 - 1
6.2	Conclusions .....	6 - 3
6.3	Recommendations.....	6 - 4

APPENDICES

Appendix

A	Open House Material
B	Community Survey
C	Diesel Generating Station Environmental Screening
D	Small Hydro Memos
E	Wind Memos
F	Yukon Energy Grid Option Report
G	Energy Efficiency Report

## DISCLAIMER

This report was prepared solely for internal purposes. All parties other than BC Hydro are third parties.

BC Hydro does not represent, guarantee or warrant to any third party, either expressly or by implication:

- (a) the accuracy, completeness or usefulness of,
- (b) the intellectual or other property rights of any person or party in, or
- (c) the merchantability, safety or fitness for purpose of,

any information, product or process disclosed, described or recommended in this report.

BC Hydro does not accept any liability of any kind arising in any way out of the use by a third party of any information, product or process disclosed, described or recommended in this report, nor does BC Hydro accept any liability arising out of reliance by a third party upon any information, statements or recommendations contained in this report. Should third parties use or rely on any information, product or process disclosed, described or recommended in this report, they do so entirely at their own risk.

## COPYRIGHT NOTICE

This report is copyright by BC Hydro in 2004 and may not be reproduced in whole or in part without the prior written consent of BC Hydro.

## EXECUTIVE SUMMARY

Atlin is one of BC Hydro's Non-Integrated Areas (NIA), situated in North-western B.C., near to the Yukon border. It is an off-grid community with its electricity needs served from the BC Hydro diesel-generating station. The Atlin Community Energy Plan project was a co-operative effort of BC Hydro and the Taku River Tlingit First Nation (TRTFN). BC Hydro managed the project and undertook the work required for the assessment of alternative energy options. The TRTFN worked in conjunction with BC Hydro to co-ordinate the community involvement tasks and to provide information needed for the energy profile.

The key goal of the Atlin CEP has been to ensure the community as well as BC Hydro have a clearer understanding of the options and related impacts and costs of alternatives to diesel through exploring current and future energy needs and developing the database of information for the supply and demand options. Through the CEP project several energy supply options and opportunities have been identified and investigated. These include potential alternatives to diesel generation (wind, small hydro and connection to the Yukon grid), conservation measures to reduce the costs and impacts of electricity use, and the related environmental and social impacts.

While the existing diesel generation plant can serve the community for many years, because of its extra capacity, the equipment will need to be replaced due to wear, age and desired improvements in efficiency. The high unit cost to BC Hydro of operating a diesel facility creates the opportunity to consider other options. The economic analyses show that an alternative supply option could be economically feasible as a long-term solution. Other attributes of the alternatives, including the use of renewable energy with low emissions and local economic development, strengthen the case for implementing a change to the current system.

There are three viable options for the future electricity supply in Atlin:

- Continuation with the status quo diesel generation
- Development of a local small hydro plant, with diesel generation on stand-by

- Connection to the Yukon Grid via a power line along Atlin road , with diesel generation on stand-by

While the wind-diesel hybrid is not considered viable under commercial terms, the option should be considered if substantial funding is available for development as a new use of technology.

The selection of a preferred option will depend on the actual cost effectiveness, determined through a competitive process, and the interest of BC Hydro and the community in the different attributes of the options.

Efficiency measures have been identified that can deliver energy and cost savings to individuals as well as the community. These can be implemented with any of the supply options.

The selection and implementation of an alternative supply option or energy efficiency measures will not impact the electricity rates for BC Hydro customers in Atlin.

Based on the results and conclusions of the CEP, the following actions are recommended:

- Share the findings of the CEP with the community through an open meeting.
- Define the terms of reference for a Request for Proposals (RFP), Expression of Interest (EOI), or similar process for the small hydro and grid connection options. The purpose of the RFP/EOI would be to identify proponents to develop the project and determine the most cost-effective option. The terms of reference for the RFP/EOI process should specify community involvement and benefits.
- Investigate enabling mechanisms to implement the energy efficiency measures. The provincial and federal governments have programs to fund communities to develop projects that improve energy efficiency, reduce energy costs, and reduce climate change impacts.
- Investigate if substantial federal funding is available for a wind-diesel hybrid system with energy storage, as a development project in research for northern/remote areas.

## SECTION 1.0 - INTRODUCTION

### 1.1 BACKGROUND

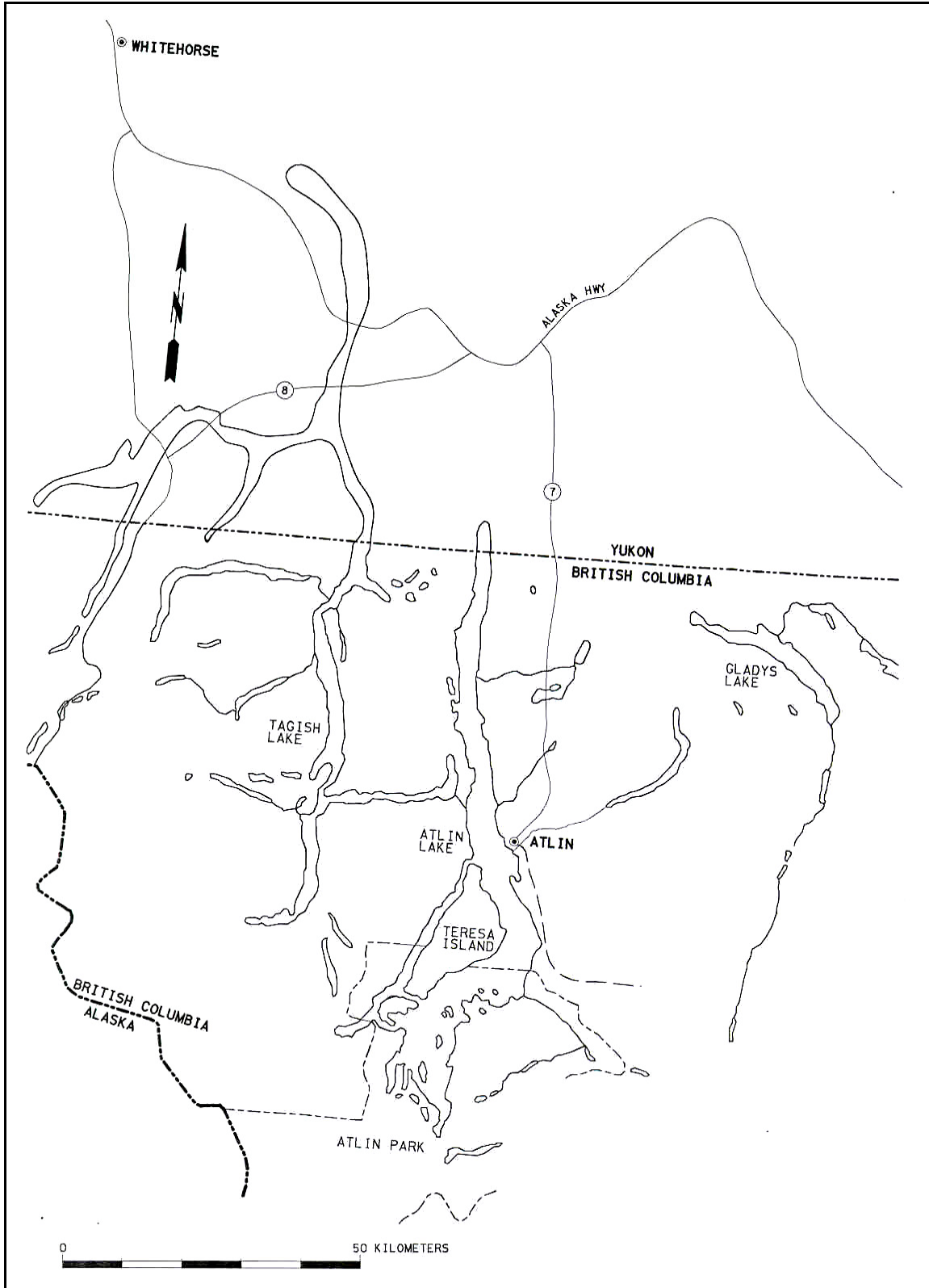
Atlin is one of BC Hydro's Non-Integrated Areas (NIA), situated in North-western B.C., near to the Yukon border. It is an off-grid community with its electricity needs served from the BC Hydro diesel-generating station. The Taku River Tlingit First Nation (TRTFN) are the only local form of government in the community of Atlin.



In 2001, TRTFN approached BC Hydro's ARD for support with investigating the development of a sustainable electricity system for Atlin. At the time, the Aboriginal Relations Department (ARD) and the Green & Alternative Energy Division (GAED, now in Distribution) groups were jointly developing a Community Energy Planning (CEP) pilot for First Nations communities with a goal to use the CEP process in 2-3 distinctly different remote communities. Atlin was selected as one of these communities. Such a project would involve an assessment of the community's energy needs and opportunities for a sustainable energy system, and the related impacts and costs.

The key goal of the Atlin CEP has been to ensure the community has a better understanding of the options and related impacts and costs of alternatives to diesel through exploring current and future energy needs and developing the database of information for the supply and demand options.

As this is a community energy planning project, the involvement of the community in the process is paramount. Education and consultation activities have helped to shape the energy needs of the community and ensure involvement and engagement in the outcome.



**Figure 1-1: Location Map**

## 1.2 **OBJECTIVES**

The CEP for Atlin is a study of energy use and options. The components of the study were laid out in the project plan as follow.

1. **Develop an Energy Profile for the Community:** by studying current electricity profile information and surveying the community.
2. **Assess possible options for a more sustainable community energy system in Atlin:** by looking at the opportunities for wind, small hydro and other system options
3. **Explore energy efficiency and other concepts that would contribute to a CEP:** by looking at how the community can use energy more efficiently and can implement Power Smart programs.
4. **Build awareness of energy issues:** by undertaking community consultation, education and awareness activities.
5. **Deliver a final report:** which provides an assessment of the opportunities and constraints of energy demand and supply.

The Atlin Community Energy Plan project was a co-operative effort of BC Hydro and the TRTFN. BC Hydro managed the project and undertook the work required for the assessment of alternative energy options. The TRTFN worked in conjunction with BC Hydro to co-ordinate the community involvement tasks. The TRTFN contracted the ATDC (Atlin Tlingit Development Corporation) to do the community consultation tasks including the Open House and Community Survey. The TRTFN also assisted in providing information needed for the energy profile.

Within BC Hydro, several groups were involved in both the development and implementation of the project including: ARD, GAED (now within Distribution – Power Planning and Portfolio Management), NIA Operation (Field Services), Distribution Planning (Strategic Asset Management Group, Distribution Operations), Sustainable Energy Solutions (Engineering) and Power Smart (Outreach team and residential program).

### 1.3 SCOPE AND METHODOLOGY

The study was done at a pre-feasibility level. The investigations were performed to the level required to make an adequate estimate of the potential and associated costs of each component.

#### Energy Profile

The energy profile was developed to provide an understanding of how the community uses energy and to feed the evaluation of potential energy systems. Existing BC Hydro information was used to determine the current and forecast electricity profile of the community. A survey of the community was also implemented through TRTFN.

#### Energy System Options

The opportunities for alternative sustainable energy supply were assessed to compare potential options for future systems to the status quo diesel of diesel generation. The options evaluated included wind energy, small hydro and connection to the YEC Grid.

#### Environmental Screening

Preliminary analyses of the potential environmental impacts and benefits of the different energy system options were completed to further the evaluation of options alongside economic and social factors.

#### Assessment of Energy Efficiency

An energy efficiency audit was performed to identify what electricity and cost savings are possible at a community level.

#### Community Participation and Consultation

This task involved gaining input from the community throughout the stages of the CEP project as well as educating the community about energy use, system options and energy efficiency. Building support in the community started at the early stages of the project and has involved the leadership of the TRTFN. The TRTFN managed part of this task through ATDC to organize the consultation

and involve key community members. A community survey, Open House, articles in the local paper were all part of community involvement activities. In addition, the Power Smart Youth team presented and provided information to the community and local school in Atlin.

#### CEP Report

This report is a summary of the information gathered and an evaluation of potential options for the energy future of Atlin. It will be used by BC Hydro to consider options for the Atlin NIA, and as an example for other communities and alternative energy work. It will help build the knowledge capacity within the TRTFN and community of Atlin and assist them in the involvement for their energy future.

#### Availability of Reports

The final report will be issued to BC Hydro and the TRTFN. Presentation of the results will be made to the Atlin community and available to the public at large.

## **SECTION 2.0 - COMMUNITY (INFORMATION, EDUCATION, CONSULTATION)**

There are several components to community involvement and the methods and activities used vary depending on the stage and scope of the project. The goals that were identified for this project included education and awareness of general energy information and local energy issues; consultation on the project including energy use and alternative supply options, and capacity building. As this project is part of the CEP pilot, learning what did and didn't work from a community perspective is important as well.

### **2.1 EDUCATION AND AWARENESS**

In order for the community to participate meaningfully in a community energy planning process they need to be well informed. Several activities have been implemented in order to achieve this information and participation. Regular communication with Peter Kirby of the TRTFN and Stuart Simpson of Atlin Tlingit Development Corporation (ATDC) informed on the progress and findings of the project. Peter and Stuart formally, through local newspaper articles, and informally through conversations and meetings, advised the community of the CEP progress. There were challenges in keeping good communications at all times. The project was managed from the engineering office in Burnaby and Atlin is at the other end of the province. The remoteness made regular face-to-face meetings unfeasible, however these were arranged when possible. Also, all parties have other responsibilities and priorities, which sometimes delayed responses and progression. For future projects, a more formal reporting and meeting schedule may help this situation.

The community Open house on 12 February 2003 at the community centre was a key event that launched the project in the community. Elementary and high school students were brought in from the school to participate in Powersmart story telling and activities. Posters about Atlin's energy use, CEP, and supply options were displayed throughout the Open House. The Power Smart youth

team had a booth with information about energy efficiency and power smart products. Energy efficient CFL light bulbs were distributed to attendees. The BC Hydro and TRTFN team presented the plan for the CEP project and preliminary energy option information. A question period followed the presentation. BC Hydro participants included Helen Hamilton Harding, John Emery, Randy North, Paul Ng, and Davin Greenwell and Anastasia Lloyd of the Power Smart Youth team. TRTFN representative, Peter Kirby and ATDC representative Stuart Simpson also participated. See Open House material including advertisement, event plan, posters and a summary of the event in Appendix A.



**Photo 2-1 Open House: Kids learning about energy efficiency, CEP team, question period, poster display**

## **2.2 CONSULTATION**

Consultation involved getting input from the community about the issues being considered in the project. Key consultation activities included ongoing input from the community leads, the Open House question period and informal discussions, and the door-to door community survey.

The community survey was undertaken as a tool to engage the residents of Atlin regarding the CEP and learn about the community's energy awareness, use and preferences. Details of the community survey are included in Section 3.0 - Energy Profile.

The Open House provided the opportunity for BC Hydro team members to meet directly with the community, ask and answer questions and discuss energy issues. Some observations from those interactions include:

- Strong support for renewable energy supply options, especially for small hydro.
- Desire to understand how a different energy supply project would be developed: who would own, operate, and take responsibility for electricity service in the community.
- Awareness of the high unit cost of their electricity and interest in long-term solutions.
- Concern about privatization and rate review issues of BC Hydro and what effect it may have on their community.
- Taku River Tlingit First Nation have indicated, through their position on the “Redfern Mine Proposal”, that their interests must be accommodated. Similar expectations could apply for an energy project.
- Potential energy efficiency opportunities in the community for residential and community buildings.

### **2.3 CAPACITY BUILDING**

One of the key objectives of the CEP project, particularly from the TRTFN’s perspective, was capacity building. They wanted to glean as much learning, training, and work opportunities from the project as possible. This was achieved in the project formally, through framework and capacity agreements with the TRTFN for specific tasks, and informally as opportunities arose through the project. The tasks for TRTFN included:

- Collect and provide community information such as population statistics and development plans.
- Conduct door-to door energy survey in Atlin, and develop a database for survey results.
- Winter Observer work: inspection of the wind monitoring equipment on Monarch Mountain.
- Event and venue co-ordination for the open house
- Ensuring continual meaningful consultation of the whole of the Atlin community in the CEP process.
- Review, comment and input on project documents.

Informal capacity building activities that occurred included:

- Participation in the Yukon Wind Energy conference.
- ATDC and local residents helped with the installation of the wind-monitoring tower on Monarch Mountain along with BC Hydro employees. They had also helped with the decommissioning of the collapsed wind tower.
- Local residents were hired to help with energy efficiency audits and the community survey.

## **SECTION 3.0 - ENERGY PROFILE**

Development of an energy profile for Atlin is necessary to understand the current and potential future energy scenarios. An energy profile includes the quantitative component, how much energy is being used and at what cost, and the qualitative, how is it being used. Using records of energy use to understand the past and current situation allows the probable future scenario to be forecast. The energy profile provides the baseline by which to develop and compare supply options for the future. The future peak load and annual energy demand are needed to anticipate expansions to generation capacity and size potential alternative generation. Development of existing and future costs is required to compare economic feasibility of different options.

### **3.1 COMMUNITY PROFILE**

Electricity use is tied to population, commercial and institutional activity, and the types of buildings, equipment and appliances that are used. The existing population of Atlin varies seasonally and somewhat with the influence of mining industry. Winter populations are around 350, rising to over 500 in the summers.

BC Hydro's has about 482 customers: 377 residential and 105 commercial/small industrial accounts. In addition it has services for it's own facilities and street lighting.

The community has about 250 houses, about 50 of which are on the TRTFN reserves. The largest consumers of electricity in Atlin are the school, hotel and two grocery stores. More information about the buildings and electrical equipment can be found in the energy efficiency study, Appendix F.

### **3.2 DEMAND ASSESSMENT**

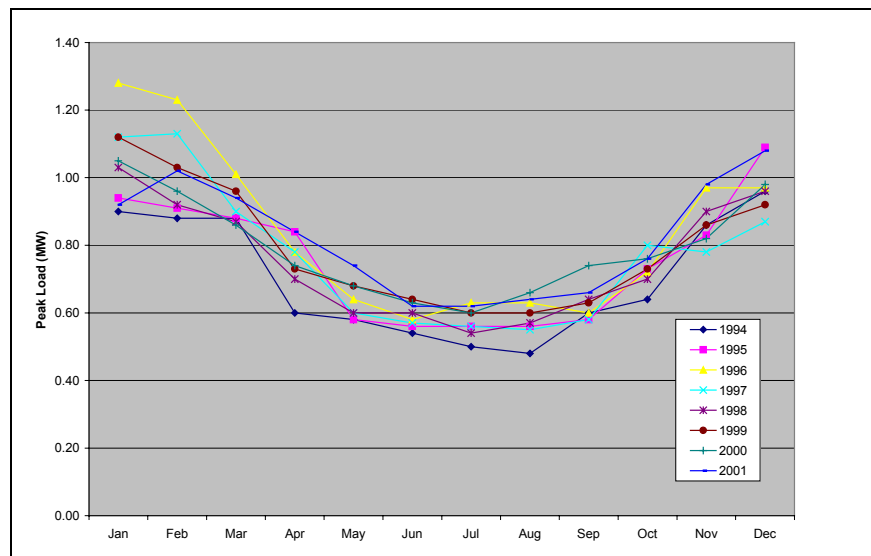
The demand assessment is based on existing load and projected load growth. Because the existing Atlin system is isolated (not integrated with the provincial grid) local generation is required to meet the capacity and energy needs of the customers. In the BC Hydro Non-Integrated Area system, incremental load

growth is met with incremental increase in generation and transmission capacity. Large increases in the load require negotiation on a case specific basis. For the purposes of this study, only incremental load growth was considered. Large commercial and industrial development has not been considered, as accurate information on potential economic development is not readily available.

For the purposes of forecasting for future electrical demand, annual growth of 2% is assumed for load and annual energy use. This is representative of the average of the last 8 years. It is also in the order of growth rates generally used for population in community development planning. Practically, the capacity of the existing diesel station can accommodate growth for several years, and the actual trends in growth should be monitored. Because of the small population and corresponding demand, the energy profile can be sensitive to changes that would be considered insignificant in the larger centres on the integrated system.

Graphs showing different aspects of the load profile are included and discussed below.

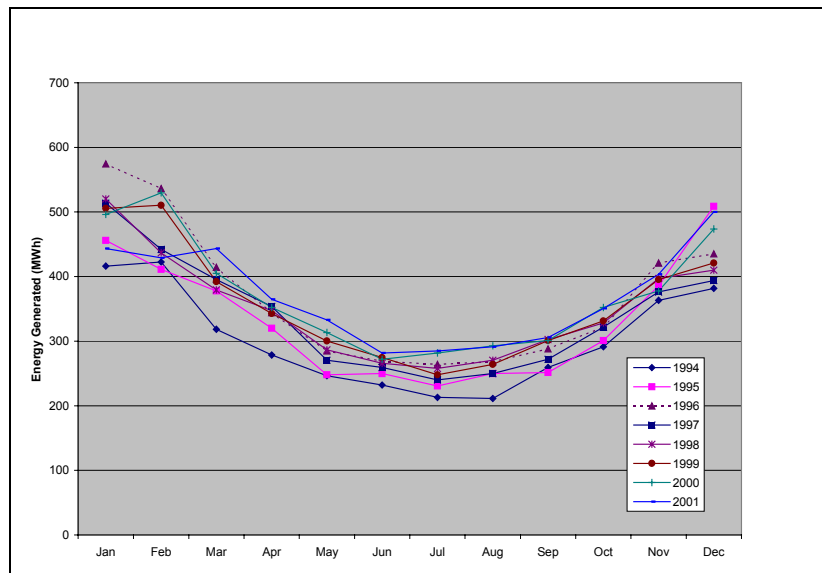
**Figure 3-1: Historical Monthly Peak Load**



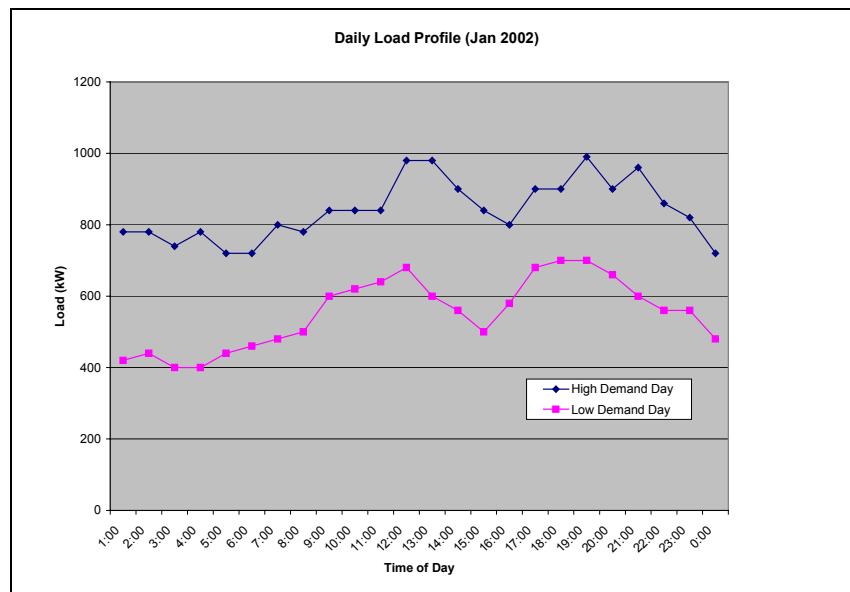
The chart above shows the profile of the monthly peak loads for years 1994 through 2001. The highest peak, historical peak load, is 1.28 MW, which occurred in January 1996. The profile of the load is seasonal, with the highest

loads occurring in the winter months (larger lighting and heating demand) with much lower loads occurring in the summer. This is despite the influx of population that generally occurs in the summer in Atlin. The chart below shows monthly generation in MWh. The highest historical generation of 574 MWh occurred during the same month as the peak load, January 1996. The generation also follows a similar seasonal profile.

**Figure 3-2: Historical Monthly Generation**

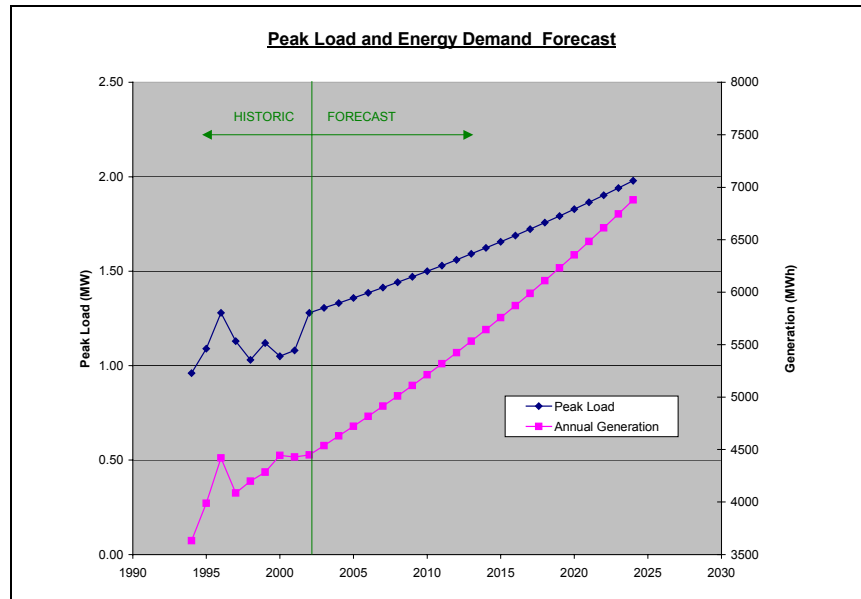


**Figure 3-3: Daily Load Profile (Jan 2002)**



The daily load profile chart shows how energy use varies throughout the day and the difference between a high demand day and a low demand day. The peaks are at the middle of the day and around dinnertime in the evening. This is typical of a residential load profile.

**Figure 3-4: Peak Load and Energy Demand Forecast**



The chart above shows historic records of energy profile and a forecast profile. A future growth rate of 2% is used for both the peak load and annual generation. A 20-year time period is used for the forecast as this is commonly used for energy planning and project comparison. The forecasted peak load for 2024 is 1.98 MW. 2.0 MW is used for the practical purposes of sizing capacity. The forecasted annual generation for 2024 is 6880 MWh. These values are used to generate future daily and monthly profiles for developing alternative supply options.

### 3.3 CURRENT ECONOMICS

Atlin is part of BC Hydro's Non-Integrated Area (NIA). BC Hydro currently serves 9 NIAs with a total population of 6,291. Each of these communities is served via a local generation and distribution system. The primary source of power for the majority of these communities is diesel-based generation. Some

communities' generation is supplemented by purchases of independent power, such as small hydro.

NIAs are billed according to the Zone 2 Tariff structure. It is different than the Tariff for the integrated area with marginal costs applied for levels of consumption. The structure is laid out in Table 3-1. A major difference in the Zone 2 situation is that if a significant expansion of the system (generation or distribution) is required to serve a new load, the proponent of the new load must share a higher percentage of the cost. In the integrated system, depending on the proximity, there is generally enough supply that new loads only have to contribute to the cost of the connection.

**Table 3-1: Zone 2 Rate Structure**

Residential:	Bi-monthly	Basic charge First 3000 kW.h Additional kW.h	\$6.92 @ \$0.0577/kW.h @ \$0.0991/kW.h
Non-Residential: Under 35 kW:	Bi-Monthly	Basic charge First 14000 kW.h Additional kW.h	\$8.29 @ \$0.0649/kW.h @ \$0.1080/kW.h
Over 35 kW:	Monthly	Basic charge First 200 kW.h per kW of demand Additional kW.h	\$4.15 @ \$0.0649/kW.h @ \$0.10.80/kW.h

Note: For detailed and revisions refer to the British Columbia Hydro and Power Authority Electric Tariff.

All of BC Hydro's non-integrated areas operate at a deficit as isolated systems. However, they do this to provide a similar level of service to the NIAs as available in the integrated areas of the province. As such, the deficit is a cost of meeting the obligation to serve.

The cost of diesel generation and the size of the community result in a high unit cost of energy. On the integrated system, there are several large generating facilities and areas of large dense population. These factors contribute to flexibility in annual operation and economies in scale, resulting in much lower

overall unit costs (below the customer rates). The table below shows a breakdown of the current Atlin plant costs.

**Table 3-2: Current Atlin DGS Unit Costs**

Cost Description	Unit Cost (\$/kWh)
Fuel Cost	\$0.13
Generation Cost	\$0.06
Distribution Cost	\$0.04
Total Cost of Energy Supplied	\$0.23
<i>Revenue / energy supplied</i>	<i>\$0.06</i>
Net Marginal Cost	\$0.16

Notes:

1. Costs are based on the average of fiscal years 1999/2000 to 2001/2002 (April 1 to March 31).
2. Information is from BC Hydro NIA records.
3. Costs are based of amount of energy supplied = Generated kWh – Station Own Use kWh

The cost of distribution will not change with an alternative supply option. There are also additional costs for maintaining the diesel plant on stand-by for some of the options.

These unit costs were used to assess opportunities in the economic analyses of the alternative supply options and energy efficiency measures. The economic analyses are discussed further in Sections 4 and 5. It should be noted that a change in the supply source or in the costs of the Atlin NIA will not effect the tariff and therefore the rates paid by customers in Atlin.

### **3.4 COMMUNITY SURVEY**

A community survey was undertaken to engage the residents of Atlin regarding the CEP and learn about the community's energy awareness, use and preferences. The survey results can be used to help frame the future energy options for Atlin and to develop strategies for ongoing community involvement.

The survey was conducted in the autumn of 2003 by ATDC through the TRTFN. The survey consisted of 34 questions and focused on building type, heating methods, energy use and energy preferences. The results were compiled into a Microsoft Access 2000 database and submitted to BC Hydro Engineering for use in the study.

A total of 57 residences participated in the survey, representing only approximately 22% of the population. The church, store, one mobile home (off reserve) and one townhouse (on reserve) were also surveyed. The results should be extrapolated and used with caution, as they do not necessarily represent the whole community.

Results pertaining to energy use habits should be considered with the development of an energy efficiency initiative in the community. Community interests in the attributes of different supply options should be considered in the process of implementing any changes to the existing system.

Results show that Atlin residents have knowledge about energy supply and efficiency. The respondents indicated that the most important characteristics of an electrical supply system are to have a low local environmental impact, while being cost effective. A summary of the survey results is included in Appendix B.

## SECTION 4.0 - SUPPLY OPTIONS

One of the objectives of the Atlin CEP project is to investigate alternatives to the existing diesel generation system. The interest to do this stems from the availability of renewable resources in the area and the dissatisfaction of high cost and negative impacts of the diesel plant. Small hydroelectric power is considered as it has previously been identified to have potential. On an early site visit to Atlin the potential for wind energy was identified as worthy of investigation.

Other renewable resources such as biomass and geothermal were considered only in the preliminary stages of planning the study. Though there may be a sufficient biomass resource in the area, the technology for small, off-grid systems is not commercially available. Similarly, there may be geothermal resources in the area, but the cost of proving a resource for electricity generation is prohibitive for a potential project of this size. Local geothermal resources may be beneficial for geo-exchange systems used in heating for buildings. This could be explored further as part of a community development activity. With the knowledge of potentially good hydro and wind resources these other renewables are not likely to be competitive at this time and were not investigated further.

In addition to local resources, connecting to the Yukon Grid was also considered as a supply option.

Separate studies were done for each of the supply options to assess the resource potential, the technical and economical feasibility of developing a project, and the social and environmental attributes. The following sections provide a brief summary of the key elements of each of the supply options. A discussion comparing various components of the options follows with a summary table. Refer to Figure 4-1 for the location of the supply options.

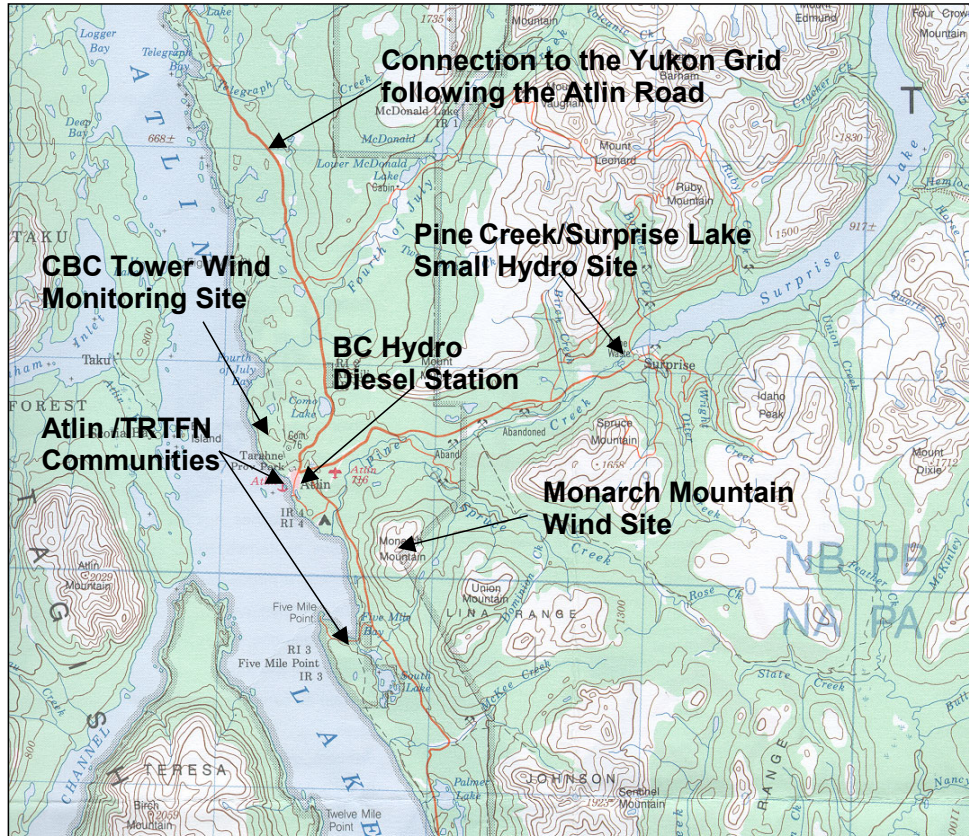


Figure 4-1: Atlin Energy Resources

#### 4.1 EXISTING DIESEL

The present Atlin Diesel Generating Station (DGS) was constructed in 1978 and operates as the prime power source. An earlier station consisting of mobile generators was located immediately east of the present site for approximately 10 years prior to 1978. The site is located in a rural residential area, on the corner of 6<sup>th</sup> and Discovery Avenue just east of Atlin town site. Equipment on site includes a switchyard, two mobile diesel generators, a powerhouse containing three diesel generators, a used-oil furnace, an office, a workshop and control panel, a tank farm holding two large diesel tanks (8000 and 20,000 gal) and a smaller waste lubrication oil storage tank.

Some of the negative impacts associated with diesel generation include fuel spills and emissions. An environmental screening of the Atlin DGS was done as

part of the CEP report and is included in Appendix C. Overall site containment has been determined as acceptable, however full containment of all oil and fuel containing structures would prevent potential releases to surrounding drainage ditches.

Emissions from Atlin DGS include NO<sub>x</sub>, CO, CO<sub>2</sub>, and particulate matter (PM). Both PM and NO<sub>x</sub> are included in the Canadian Environmental Protection Act's (CEPA) toxic list due to their potential health impacts. Greenhouse gas (GHG) contributions include both CO<sub>2</sub> and NO<sub>2</sub> emissions. Based on emissions per MWh, emissions from the Atlin DGS are considered high for all pollutant parameters. Atlin DGS greenhouse gas emissions, about 3,000 Tonnes per year, account for a very small fraction of BC Hydro's total (less than 0.5%). However, over the next 20 years, if diesel generation were continued, a total of about 87,000 Tonnes of GHGs would be emitted.

To date, no emissions control upgrades have been completed at the Atlin DGS. BC Hydro currently holds a permit and complies with the BC Ministry of Water Land and Air Protection for the discharge of emissions from up to six small-bore reciprocating engine diesel generators at the Atlin DGS.

The existing diesel generating system meets the electrical needs of Atlin. If it continues to be the only supply source, upgrades of the plant will be required.

## 4.2 **SMALL HYDRO**

Historically there were at least two hydro projects on Pine Creek supplying power to mines in the Atlin area. There has also been a weir located at the outlet of Surprise Lake to regulate flows in Pine Creek. The existing bridge is built over a wooden structure that currently has a controlling effect on Surprise Lake outflows.

During the 1980's and 1990's, a few studies were made of hydro potential in the Atlin area. During this period, BC Hydro sent out a request for proposals for alternative energy options for remote northern communities including Atlin. One

study of the area for Yukon Electric (by Klohn-Crippen) examined using Pine Creek with storage on Surprise Lake as a power source (8.5 MW) for the Yukon grid and Atlin. Another proponent proposed a smaller project on Pine Creek to supply Atlin alone. The small hydro potential was reviewed for the CEP. A memo containing the details of the study is included in Appendix D.

Pine Creek was the only creek near Atlin to have a large enough drainage area and the lake-storage potential to provide for the year-round energy needs of the Atlin community. A number of project layout options on Pine Creek were considered including plants with sizes of 1000, 1500 and 2000 kW. Hydrology and power studies were completed and preliminary cost estimates prepared for the economic analysis.

The major environmental issue identified was fish and the required riparian flows in Pine Creek. Additional background data collection, field data collection and design details are required for a more complete assessment of potential impacts on fish and wildlife, however, they are not prohibitive to development at this stage. Issues include stream habitat loss, development of barriers to fish migration, changes to lake habitat, fish entrainment at the intake, insufficient minimum flows and removal of peak flows. Wildlife issues include flooding of terrestrial/riparian habitat around the lake (for example nesting birds) and clearing of habitat.

The 2000 kW project can fully provide for the current Atlin load as well as for 20 years of load growth at 2%. Diesel backup would only be required during unit outages.

The 1500 kW project can fully provide for the current Atlin load as well as for 8 to 12 years load growth at 2%. Initially diesel backup would only be required during unit outages. With load growth over time, diesel support will be required for peaking and load support in the winter. After 20 years of 2% load growth, the 1500 kW project will still be able to provide for about 98% of Atlin's electrical needs.

The 1000 kW project can not fully provide for the current Atlin load. Diesel backup would be required for peaking and load support in the winter, and during unit outages. Initially the 1000 kW unit could provide for about 96% of Atlin's electrical needs. After 20 years of 2% load growth, the 1000 kW project will still be able to provide for about 82% of Atlin's electrical needs.

With a 2000 or 1500 kW hydro plant, the diesel plant can remain on standby. This would almost eliminate fuel costs, greatly reduce other operation and maintenance costs, postpone further diesel unit replacement, and allow for the relocation of some of the existing diesel capacity.

Local employment opportunities would exist during the construction of the project. There would be some ongoing operation and maintenance employment as well.

### 4.3 **WIND**

A wind-diesel energy supply system study was completed as part of the CEP. The study aimed to broadly investigate the potential wind resource and feasibility of building a wind-diesel system based on the existing diesel plant. The study included wind site identification and assessment, resource analysis and energy estimate, preliminary environmental assessment, initial wind-diesel system optimization and economic analysis. A memo summarising the results of the study is included in Appendix E.

Two sites for installation of the wind turbine component of the wind-diesel system were identified: CBC Tower, and Monarch Mountain. The CBC Tower site is located approximately 1.5 km north of the Atlin town site. BC Hydro mounted wind measuring equipment (anemometer and vane) on the existing CBC communications tower at 17 m and 30 m in January 2002. The site is on a small hill that has a moderate drop towards the lake, and good exposure to the south, south-west winds.

Monarch Mountain (elevation 4723 feet/1439 m) is located approximately 5 km south-east of Atlin. The site has some low scrub vegetation, but a very good exposure to winds from the south and west. BC Hydro installed a 50 m meteorological mast in October 2002, with anemometers and vanes at 30 m and 50 m. The site is not accessible by road, and is a popular hiking destination for locals.

Wind and temperature data was collected for both sites for resource assessment. Details of the data collection and analysis methods are included in the memo. Different configurations of wind turbines were then used in a model to determine energy potential and economics.

A preliminary environmental review of the two sites indicated that the main environmental issues for the Monarch site would be associated with road access particularly fish requirements at creek crossings. The CBC site is close to Atlin Lake and is likely to have a higher bird population that may cause environmental concern regarding wind turbines in the area. At this overview level of study, it is not expected that environmental issues would represent major barriers to site development. However both sites need more detailed studies to define the potential impacts and mitigation strategies.

From this analysis, it was concluded that for the most economic arrangement of wind turbines (2 x 660 kW) at the CBC site a wind-diesel system could be marginally more economic than the existing diesel only system. A wind-diesel system would displace around 500,000 litres of diesel fuel per year based on the current energy supplied (4,800 MWh/year) and extend the diesel generator life by approximately 2.5 years. The wind turbines would generate close to 50% of Atlin's energy requirements. Local employment opportunities would exist during the construction of the project. There would be some ongoing operation and maintenance employment as well.

Icing issues were not explored explicitly in the CEP study. However, there was icing on the monitoring equipment in Atlin. The wind turbines in Whitehorse

have had many ice-related challenges. Icing can be expected to be an operational challenge with wind turbines in the winter in that area.

#### 4.4 **CONNECTION TO YUKON GRID**

One of the options being considered for the supply of energy to Atlin, B.C. is a powerline linking Atlin to the Yukon's electrical grid at Jake's Corner. This powerline would supply electricity to Atlin from the existing renewable energy sources in Yukon, namely the hydro and wind facilities located in southwest Yukon. This option was investigated by Yukon Energy in the report included in Appendix F.

The powerline would connect with the existing electrical grid at Jake's Corner, at the north end of the Atlin Road, and continue south to Atlin – a total distance of about 94 km. Of this distance, approximately 43 km are within Yukon and 51 km are in B.C.



**Photo 4-1: Transmission line and right-of-way, Alaska Highway west of Jake's Corner**

Between Jake's Corner and Atlin, the route for the powerline would generally run to the east of the Atlin Road. A preliminary route reconnaissance indicated that

in many locations, it might be preferable to locate the powerline up to half a kilometre from the road alignment to avoid adverse terrain conditions and reduce the amount of brushing required. Careful alignment of the powerline will minimize conflicts with existing titled properties and avoid difficult terrain and densely treed areas.

The line would be 3-phase, 25-34 kV, and single wood-pole construction. The required right-of-way width suggested by Yukon Energy is between 22 and 26 metres. BC Hydro's standard is narrower, between 12 and 15 metres. The line would have a capacity of 4 MVA. A small substation would likely be required at Jake's Corner to connect the Atlin powerline to the existing transmission line along the Alaska Highway. The existing diesel plant would be modified to a standby unit, available in the event of emergency.

Construction of a powerline between Atlin and Jake's Corner could enhance the potential for development of renewable energy located near Atlin. The powerline could, at some future date, be used to deliver electricity from a local source to customers in Atlin as well as enhance power supply to the Yukon grid. The powerline would also enable existing and new customers located along the Atlin Road to be supplied with electricity.

Environmental concerns associated with small powerlines are primarily linked to the clearing of the right-of-way and construction of the line itself. The choice of route location for the powerline can, to a large extent, avoid or minimize potential environmental concerns. Through careful planning and site investigations, areas of unstable terrain, critical wildlife habitat or nesting areas and key viewsapes may be avoided. The greenhouse gas intensity of the supply is assumed to be 0% as it would utilize hydroelectric (and some wind-generated) power.

Local employment opportunities exist during both the construction and operational phases of the powerline. Construction of the line is estimated to up to 1.5 years, with most of the brushing and preparation of the right-of-way done during the fall and winter to minimize risk of fire and ground disturbance. The installation of poles and conductors would be done the following summer.

The capability of servicing commercial and residential developments along the Atlin Road via the grid connection may encourage economic development. The grid provides the flexibility to serve larger commercial and industrial development.

#### **4.5 OPTION COMPARISON**

The options considered for electricity supply to Atlin include the existing diesel generating station, a small hydro project, a wind diesel system, and connection to the Yukon Grid. This CEP report provides a pre-feasibility level of information and analysis. Prior to proceeding with an alternative supply system, further analysis and consideration may be required. However, this preliminary analysis provides a basis for understanding the characteristics and attributes of different options. It should help BC Hydro and the community to identify what aspects of energy supply are important to them and assist decisions on methods to proceed.

##### **Resource Availability and Technical Feasibility**

The hydro and wind options required assessment of local resources to determine their feasibility. Both assessments showed that there is potential development of local renewables. The small hydro option has the advantage of a natural storage system with Surprise Lake. This could enable a small hydro project to be the source of primary power.

Though the wind resource assessment shows that there is potential for a wind energy project, there is more uncertainty with the feasibility than with the other options. The amount of energy available can fluctuate depending on actual wind speed and duration. This will affect amounts of diesel generation required and therefore cost. Because wind is an intermittent resource, the diesel generators will be operated as a hybrid system. This requires more complex controls than the other options. Optimization of the system can be difficult because of the varying resource and load. This too can incur higher cost than estimated. The wind energy technology is not commonly used in BC and could pose ongoing

operational difficulties associated with icing, trouble shooting, replacing parts and so on.

The Yukon grid connection is technically feasible and straightforward in terms of route and interconnection. There are some design specifications, such as line voltage, that would require further considerations.

It is feasible that the DGS continue to be the source of electricity for Atlin. Options to improve the efficiency of the plant were not considered as part of this study.

Further consideration of interconnection and system requirements is required for all of the alternatives to diesel, such as what controls would be required to run the diesel plant as back-up or stand-by. It is not considered to be critical for options comparison at this stage.

### **Power Quality and Reliability**

Power Quality was not an area of focus for this study. It should, however, always be considered in the selection of an energy option. As a small remote system, Atlin undoubtedly has power quality concerns. Voltage fluctuations are likely common as loads that have sudden start or stops such as an engine, can easily unbalance such a small system. Reliability, or frequency and duration of outages, is likely also a concern. Generally diesel generation systems have more outages, but with shorter duration than remote communities that are connected to the grid by long transmission lines.

As diesel generation should be maintained as stand-by or back-up for all supply options, the power quality and reliability should not degrade for any of them. The wind option, would likely be the lowest of the alternatives, as it would be entirely dependant on diesel for reliability, and may compromise the system by frequent switching. The small hydro may provide some improvement in terms of generation reliability, as there will be two independent systems. However, if the diesel capacity is reduced to the minimum required for back-up, the reliability may theoretically be similar. The grid connection would likely provide the most

increase in power quality and reliability. The grid would provide a higher capacity and year-round supply. In the event that the line has a fault, the back-up diesel would result in a much shorter outage, than if the line was the only supply and the outage lasted until the fault was repaired.

### **Economic analysis**

The levelized unit price of energy for the status-quo diesel system is estimated to be approximately 24 ¢/kWh. The cost to maintain the DGS as a stand-by plant is about 6 ¢/kWh, of this about 2 ¢/kWh is for operation of the distribution system. If the option requires the diesel as standby (such as the case for the hydro and grid operations) the unit generation cost must be less than 18 ¢/kWh, in order for the system to be economically feasible compared with the status quo. For the wind option, the diesel system is required to be operating in a hybrid mode. This was accounted for in economic analysis for the wind-diesel option, and can therefore be compared directly to the diesel unit cost.

An economic model was used to compare the long terms costs of the alternative options. The basic model assumptions are in line with an IPP type project development. The following assumptions were used.

- Project life of 20 years
- Inflation rate on 2% on O&M and energy price
- Debt/equity ratio of 70/30
- Commercial loan period of 10 years with interest at 8%
- Return on equity of 15% before tax
- No terminal value
- Present value assessment using an 8% discount rate
- Load growth of 2% per annum

The unit costs for the different options are summarised in Table 4-1. At this level of study, the estimates have an accuracy of +/-25%. Taking this into account, the options are all within the same range of economic feasibility.

Of the alternatives, the wind-diesel option has the lowest capital cost. It reduces the fuel costs for the diesel operation. This results in a unit cost of between

24 and 26 ¢/kWh, which is competitive with the status-quo diesel option cost of 24 ¢/kWh. The range in the wind cost is for different sites and turbine configurations.

The small hydro options have unit costs of 23 to 27 ¢/kWh. The range in the hydro costs is for the different plant capacities of the options. The smallest plant is the most economic when compared with the diesel plant, but the larger plants are within the order of magnitude.

The Yukon grid option has a unit cost of between 23 and 28 ¢/kWh. The range in the grid costs demonstrates a range of assumed energy prices.

This analysis shows that an alternative to the existing diesel plant has the potential to be an economic long-term solution. In order to obtain more certainty in the costs, the next stage of detailed design and cost estimating and/or quotes from interested project proponents would be required. The relative equivalency of the economics of the alternatives lends more importance to the consideration of other option attributes for this stage of decision-making. Factors that could improve the cost effectiveness of proceeding with an alternative include plant design optimization, lower capital costs and a greater increase in diesel fuel prices. The economic comparison will also be affected by the nature of contractual arrangement that can be attained by BC Hydro, and what financing options are available to proponents.

### **Environmental issues**

Some of the main environmental issues that were raised in this project include local and global air emissions and fish and wildlife impacts. For the small hydro project, fisheries is the main issue, and more study would be needed to determine impacts and mitigation. However, at this stage the issues were not identified as a barrier to the project. For the wind-diesel project, there will be noise impacts depending on the site for the turbines. There are also potential fish and wildlife issues associated with the access road and power line connection. The main new impacts from the grid connection would be land-use and wildlife associated with the right-of-way clearing. There would also be visual

impacts from the clearing and structure of the powerline. All of the alternatives have some impacts on land and visual vistas of the land.

Though there are new impacts associated with the alternative options, they also provide environmental benefits over the diesel plant. Both the small hydro and grid connection options will reduce the potential for spills and contamination, due to the reduced use of diesel fuel. The fuel use will not be reduced as much with the wind-diesel option, resulting in unchanged spill and contamination issues from the status quo.

The small hydro and grid options also provide a source of electricity that is generated from renewable sources with low emissions. Low emissions would reduce the local air pollution and greenhouse gas impacts. Greenhouse gas credits or funding through government programs to reduce GHGs may be available, which could improve the economics of the options.

The reduced use of the diesel would also reduce noise from the diesel plant. The renewable nature of the resources contributes to their sustainability, being more independent of global fuel pricing, and having a lower impact on the environment.

The wind-diesel option would result in electricity in Atlin being between 37 and 53% renewable, reducing proportionally emissions, noise and dependence on diesel fuel.

### **Social issues**

The main social issues identified were creation of jobs and economic development. All of the alternatives to the DGS provide employment opportunities during the construction phase. Of these, the grid connection would likely provide the most opportunities for local involvement. Long term jobs in operation and maintenance resulting directly from the projects are likely to be similar to that needed for the existing diesel operation. Since the status-quo diesel, wind-diesel, and small hydro options are all sized to meet incremental load growth, they are not likely of their own development to encourage new economic development. The grid connection will provide capacity in excess of

the other options, and could provide some incentive for larger commercial and industrial development. The grid connection could also provide the opportunity for new residential customers along the Atlin road to be connected.

**Table 4-1: Energy Supply Option Comparison**

Option	Installed Capacity (MW)	Percent Renewable	Capital <sup>1</sup> Cost (\$M)	O&M Cost <sup>2</sup> (\$000/yr)	Unit Cost <sup>3</sup> (\$/MWh)	Environmental Attributes	Social Attributes
Status Quo Diesel	2.65	0 %	0	285	242 (184)	<ul style="list-style-type: none"> <li>• High air pollutant emissions</li> <li>• Potential for spills from fuel handling and transportation</li> </ul>	<ul style="list-style-type: none"> <li>• No change</li> </ul>
Small Hydro	1 -2	82 -100 %	6.1 -8.4	119 -131	232 - 270 (174 - 212)	<ul style="list-style-type: none"> <li>• Reduced potential for spills and contamination due to reduced amount of diesel use.</li> <li>• Fish and wildlife impacts</li> <li>• Low emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Potential for significant short and some different long-term employment</li> <li>• Use of local resource</li> </ul>
Wind-Diesel	0.9 - 1.32	37 -53 %	3.7	281 ( Wind:45, Diesel: 236)	242 - 261 (223 - 242)	<ul style="list-style-type: none"> <li>• Potential Fish and wildlife impacts</li> <li>• Noise impacts</li> <li>• Reduced emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Potential for significant short and some different long-term employment</li> <li>• Use of local resource</li> </ul>
Yukon Grid	4 <sup>4</sup>	100 %	6.5	30	228-278 (170 - 220) <sup>5</sup>	<ul style="list-style-type: none"> <li>• Reduced potential for spills and contamination due to reduced amount of diesel use.</li> <li>• Land-use and wildlife impacts from clearing and line construction</li> <li>• Visual impact</li> <li>• Low emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Potential for significant short and some long-term employment</li> <li>• Increased development opportunity due to larger electrical capacity</li> </ul>

Notes:

1. Capital replacements and upgrades will be required in later years for the diesel plant, and are included in the unit cost.
2. Estimated cost of annual operation and maintenance costs in today's dollars. Standby diesel costs are not included in the hydro and grid options.
3. Levelized unit cost in 2004 dollars. Financial parameters are described in report. Numbers in brackets are the unit costs for generation without the incremental amounts for the diesel generation to be in standby mode, and local distribution system costs. This applies to the small hydro and grid options. Wind includes distribution costs only. The standby cost is estimated to be \$58/MWh. Distribution cost is \$20/MWh. (Financial analysis of diesel costs from NIA, Pun Chu, David Carlson, 2004. Costs for alternative from respective option studies.)
4. Equivalent capacity of 4 MW (4MVA).
5. An energy cost would be negotiated with Yukon Energy. This range is used for the purpose of comparison and based an energy price of \$0.02 to \$0.07/kWh.

## SECTION 5.0 - ENERGY EFFICIENCY

Energy conservation is an effective way to reduce the impacts and costs associated with energy use. Behaviours as well as technology can have an influence on energy use and determine the overall amount. There are technological developments that allow for the end use of electricity such as lighting and heating to be maintained but at a much higher energy efficiency.

Energy Efficiency Consulting was commissioned to evaluate the opportunities for efficiency and conservation in Atlin. As part of the study, a site visit was made in August of 2003. At this time, audits were performed for 29 houses and 15 non-residential buildings. These included most of the buildings with higher electricity consumption and attempted to include an example of most building types. During the audits, key information about the major electrical consuming equipment was recorded, as well as information about the occupancy and operation of the house or building. The consultant then assessed what changes could be made that would result in energy savings and at what cost. The complete report, Electrical Energy Conservation in Houses and Buildings in Atlin, BC is included in Appendix G.

Conservation measures were evaluated for reduction in energy (kWh/year) and demand (kW). The energy reductions can reduce energy costs over time and impacts associated with generation such as emissions from diesel fuel combustion. They can also have an impact on the life of generating equipment, but these savings are not quantified here. Reduction in demand can reduce pressure on the generation system during peak loading. Since demand reduction can reduce the peak load, conservation measures can also contribute to extending the life of generation equipment by delaying the need for expansion of the system.

When doing the cost analysis of the energy efficiency measures, the consultant considered the potential savings to consumers and to BC Hydro. Though some measures would be worthwhile for the home or building owner, BC Hydro may also have an interest in conservation measures due to the high unit cost of generation. The cost effectiveness of energy efficiency measures may be different with an alternative

supply option, depending on unit cost and contractual arrangements. Therefore it is difficult to determine the incentive for BC Hydro to pursue an energy efficiency initiative.

The measures with the largest savings in both residential and non-residential are changes in lighting technology. There are also many simple and quick measures that are worth implementing, such as installing or programming timers and controls, though their impact on overall energy use is not large.

Though this CEP study focused on the electricity components of energy use, the consultant looked at some insulation and sealing aspects of the buildings as they would relate to heat and energy use. It has been noted by TRTFN that there is the possibility of funding from INAC (Indian and Northern Affairs Canada) to perform Energuide audits. This would be very useful in assisting building owners in assessing what changes they can make to reduce energy waste and heat lost while creating a more comfortable living environment.

The electricity savings identified amounted to 469,844 kWh for residential, 112,800 kWh for non-residential, totalling an estimated 582,644 kWh per year. This represents 12% of the average annual demand. Payback for the measures range between less than one and 29 years. The residential measures with the best payback time include conversion of lighting to CFL, water heater wraps and Christmas lights. The non-residential measures with the best payback time include conversion of lighting, and specific upgrades in the day-care and school.

Some of these measures will also reduce the peak demand. The total demand reduction is estimated at 190 kW, 15% of the current peak. A similar percent reduction in demand applied to the 20 year forecasted peak load of 2000 kW, would represent 300 kW.

Implementation of energy efficiency measures would be beneficial to customers regardless of the of the supply system option as their rates will not change depending on the source of electricity. Benefits to BC Hydro will depend on the supply option selected and the structure of implementation.

As part of energy efficiency is behavioural, implementation of the measures should include education and awareness. If the concepts are adopted, then the measures will be sustainable as purchasing and use habits change. The community should consider adopting energy efficiency standards to any new or renovated buildings. A PowerSmart program with a focus on First Nations and remote communities is being investigated as one of the outcomes from the energy efficiency audits and CEP pilot.

## SECTION 6.0 - DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

### 6.1 DISCUSSION

Through the CEP project several energy supply and demand side options and opportunities have been identified and investigated. These include potential alternatives to diesel generation, conservation measures to reduce the costs and impacts of electricity use, and the related environmental and social impacts.

While the existing diesel generation plant can serve the community for many years, because of its extra capacity, the equipment will need to be replaced due to wear, age and desired improvements in efficiency. The high unit cost of operating a diesel facility creates the opportunity to consider other options. The economic analyses show that an alternative supply option could be economically feasible as a long-term solution. Other attributes of the alternatives strengthen the case for implementing a change to the current system.

#### **Energy Supply Options:**

- The small hydro, wind-diesel and grid connection options were all found to be technically and economically feasible at this level of study. Cost estimates at this stage have an accuracy of +/- 25%.
- Each energy supply option has different characteristics and attributes. The small hydro and grid options would provide electricity from resources that are renewable and have low emissions. The wind-diesel option would reduce the amount of diesel fuel used, but would still maintain the attributes of the diesel system such as the risk of spill and contamination, noise, and dependence on fuel markets. The wind-diesel option is also expected to have more uncertainty in operations controls, energy production and reliability, due to the nature of the technology and the challenges with the climate in Atlin. These issues could have a corresponding impact on the cost.

Due to the lower reduction in diesel fuel use for the wind option, and the potential complications of a wind-diesel system that could reduce the cost effectiveness, it is not recommended that it be considered further at this stage. If a commercial hybrid storage system were available that could eliminate the need for ongoing diesel generation (improved battery or hydrogen for off-grid applications), then a wind option could be more attractive. If the status quo diesel system is maintained for several years without implementation of the other options, then wind should be re-considered in the future with the advance in technology. This type of project would be likely to attract federal funding.

### **Energy Efficiency:**

There are measures that can be taken by the building owners or BC Hydro that would translate into energy and cost savings. The key opportunity is lighting, but a comprehensive list of measures was developed. These measures are straightforward to implement and the benefits can begin to be obtained immediately. The business case and plan for implementation requires development, but it is likely that a co-operative effort between the community and customers, BC Hydro, and perhaps other government funding agencies would yield benefits to all parties.

Some of the efficiency measures identified would also reduce the peak demand, up to 190 kW under current conditions, and 300 kW forecasted for 20 years. Demand-side management using efficiency measures could be considered when optimizing the design of an energy alternative to be most cost effective.

### **Environmental considerations:**

- The environmental screening did not identify any major environmental issues at this stage that would preclude any of the supply options.
- Further environmental studies would be required to reduce impacts, comply with regulations, and optimize the system performance. The project proponents would do these studies.
- The emissions from the diesel generating station are considered high for all pollutant parameters. Reduction of the use of diesel generation would improve the pollution impacts associated with electricity in Atlin.

**Community and social considerations:**

- There is a strong community interest in an alternative electricity system in Atlin. Characteristics that are important to the community are local environmental impacts and overall cost effectiveness.
- All of the supply options considered, with the exception of the status quo, would create short-term construction jobs. The longer term job implications are less certain, but it is unlikely that there would be a significant increase from the current level with the diesel station. The ability of Atlin to take advantage of job opportunities was not investigated as part of this project.
- Consultation with the community has provided valuable input to the CEP process. As the end user of any of the supply options considered, the satisfaction of the community as customers will determine whether the project is a success. Engaging the community in the process of the planning of their energy future will facilitate this.

**6.2 CONCLUSIONS**

There are three viable options for the future electricity supply in Atlin:

- Continuation with the status quo diesel generation
- Development of a local small hydro plant, with diesel generation on stand-by
- Connection to the Yukon Grid via a power line along Atlin road, with diesel generation on stand-by

While the wind-diesel hybrid is not considered viable under commercial terms, the option should be considered if substantial funding is available for development as a new use of technology.

The selection of a preferred option will depend on the actual cost effectiveness, determined through a competitive process, and the interest of BC Hydro and the community in the different attributes of the options.

Efficiency measures have been identified that can deliver energy and cost savings to the community. These can be implemented with any of the supply options.

### **6.3 RECOMMENDATIONS**

Based on the results and conclusions of the CEP, the following actions are recommended:

- Share the findings of the CEP with the community through an open meeting.
- Define the terms of reference for a Request for Proposals (RFP), Expression of Interest (EOI), or similar process for the small hydro and grid connection options. The purpose of the RFP/EOI would be to identify proponents to develop the project and determine the most cost-effective option. The terms of reference for the RFP/EOI process should specify community involvement and benefits.
- Investigate enabling mechanisms to implement the energy efficiency measures. The provincial and federal governments have programs to fund communities to do projects that improve energy efficiency, reduce energy costs, and reduce climate change impacts.
- Investigate if substantial federal funding is available for a wind-diesel hybrid system with energy storage, as a development project in research for northern/remote areas.