Aboriginal Energy Alternatives

July 2008

SUMMARY REPORT

Tim Weis, P.Eng.   Paul Cobb, B.Eng.

the PEMBINA institute

Table of Contents

1 Introduction 1

1.1 Overview 1

1.2 Community Participation 2

2 Key Results 4

2.1 Community Energy Concerns 4

2.2 Community Energy Consumption 4

2.3 Community Energy Options 6

3 Conclusions 15

3.1 Summary of Findings 15

3.2 Keys to Success 16

3.3 Barriers to Action 17

4 Appendix 19

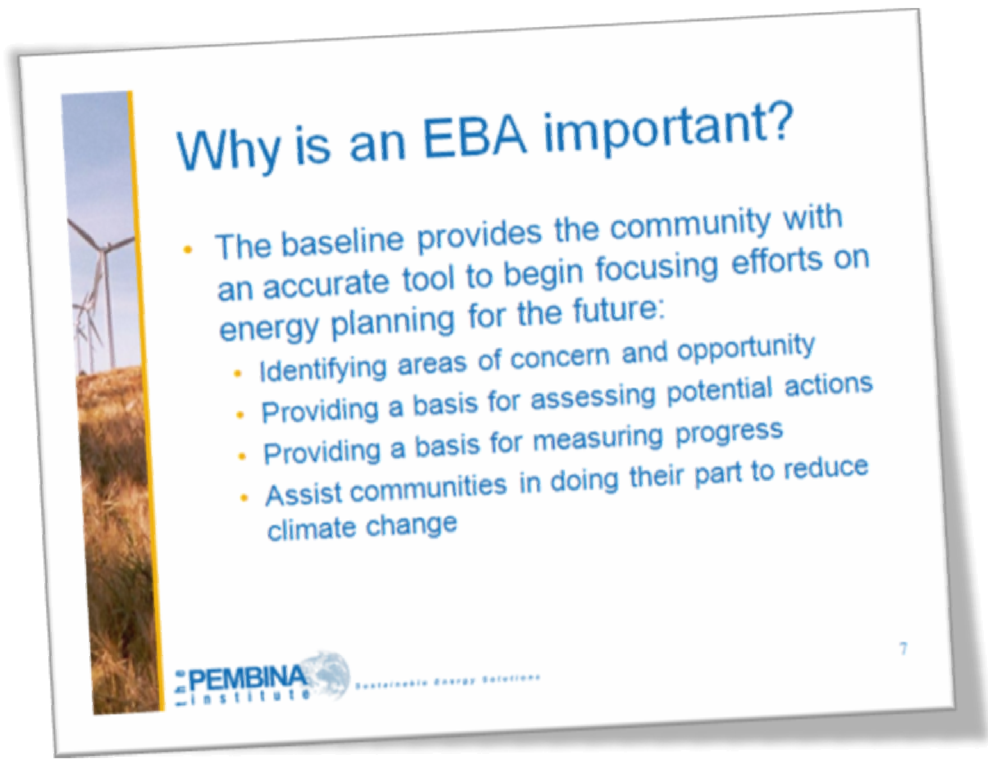
1 Introduction

1.1 Overview

The Pembina Institute has been involved in assisting communities pursue alternative energy solutions for over a decade. Much of this work revolved around "community energy baseline" projects as part of the *Aboriginal and Northern Community Action Program (ANCAP)* which was run by Indian and Northern Affairs Canada (INAC) and Natural Resources Canada (NRCan) between 2003 and 2007. During this period the Pembina Institute worked with 60 First Nations across Canada to complete baseline projects. The goals of these reports were to:

- Determine where energy is used in the community;
- Determine the breakdown of costs – economic and environmental;
- Suggest energy and cost savings opportunities that may exist in the community;
- Suggest energy supply options that may exist in the community; and
- Provide a foundation for energy planning in the community.

As shown in the slide below, an energy baseline assessment (EBA) was completed for communities in the hope that it would be a planning tool for pursuing energy efficiency and renewable energy projects.



This report highlights the major collective findings of this work, common opportunities and key challenges to overcome. This effort was made possible by support from Conoco Phillips.

1.2 Community Participation

Communities that participated in energy baseline studies are listed in the table below. The Institute has also worked with a number of communities, both First Nation and otherwise on more detailed community energy planning processes, which have typically involved multi-year partnerships and frequently centre on a specific energy alternative or suite of alternatives. As this report focuses on the results from the energy baseline studies, these projects are not included specifically, but do inform the results in an indirect manner.

Community Name	Province	On-grid	Off-grid	Study Year
Tallcree First Nation	AB	•		2005
Chipewyan Prairie First Nation	AB	•		2004
Beaver Lake Cree Nation	AB	•		2004
Saddle Lake Cree Nation	AB	•		2005
Samson Cree Nation	AB	•		2005
Blood Tribe	AB	•		2004
T'suu T'ina Nation	AB	•		2005
Enoch Cree Nation	AB	•		2005
Alexander First Nation	AB	•		2004
Kluskus First Nation	BC		•	2005
Kitasoo First Nation	BC		•	2005
Tsawatanaieuk First Nation	BC		•	2005
Ehattesaht First Nation	BC		•	2005
Toquaht First Nation	BC		•	2005
Samahquam First Nation	BC		•	2005
Skatin First Nations	BC		•	2005
Uchcuklesaht First Nation	BC		•	2005
Cowessess First Nation	SK	•		2005
Gordon First Nation	SK	•		2004
Kinistin Saulteaux Nation	SK	•		2006
Red Pheasant First Nation	SK	•		2004
Beardy's and Okemasis First Nation	SK	•		2004
James Smith First Nation	SK	•		2005
Mistawasis First Nation	SK	•		2006
Ahtahkakoop First Nation	SK	•		2004
Flying Dust First Nation	SK	•		2006
Waterhen Lake First Nation	SK	•		2004
Birch Narrows First Nation	SK	•		2006
Hatchet Lake First Nation	SK	•		2005
Black Lake First Nation	SK	•		2005
Fond du Lac First Nation	SK	•		2005
Swan Lake First Nation	MB	•		2006
Peguis First Nation	MB	•		2004
Rolling River First Nation	MB	•		2004
Skownan First Nation	MB	•		2004
Barren Lands First Nation	MB	•		2004
Northlands Dene First Nation	MB		•	2006
Sayisi Dene First Nation	MB		•	2006
St. Theresa Point First Nation	MB	•		2005
Wasagamack First Nation	MB	•		2005

Garden Hill First Nation	MB	•		2005
Red Sucker Lake First Nation	MB	•		2005
God's Lake First Nation	MB	•		2005
Manto Sipi First Nation	MB	•		2005
Bunibonibee First Nation	MB	•		2005
Shamattawa First Nation	MB		•	2006
Keewaywin First Nation	ON		•	2006
Kitchenuhmaykoosib Inninuwug First Nation	ON		•	2006
Wapekeka First Nation	ON		•	2006
Kasabonika Lake First Nation	ON		•	2006
Pic Mobert First Nation	ON	•		2006
Wunnumin Lake First Nation	ON		•	2007
Weenusk First Nation	ON		•	2007
Poplar Hill First Nation	ON		•	2007
North Spirit Lake First Nation	ON		•	2007
Kingfisher Lake First Nation	ON		•	2007
Eabametoong First Nation	ON		•	2007
Wawakapewin First Nation	ON		•	2007
Cree Nation Nemaska	PQ	•		2007
Total		**37**	**23**	

As can be seen above, close to two-thirds of the participating communities were connected to their provincial utility for electricity, while the remainder generated their power using diesel engines. In many cases the specific issues were similar in both types of community, although at times being off-grid lends itself to unique challenges. Recommendations in this report are applicable to both types of communities unless specifically suggested otherwise.

2 Key Results

2.1 Community Energy Concerns

As part of the baseline studies, meetings were held with local community decision makers such as Chief and Council, Band Manager, or other band employees. In the case of Manitoba communities, individual homes were also surveyed as a part of the data collection process. These meetings informed those involved about the purpose of the work, the data that was being collected and asked for their input on local energy concerns, and their reasons for participating in the baseline studies. Below are the most common responses:

- Rising energy costs for community members
- Reduce energy costs to Band spent on building heating and electricity
- Opportunity to develop a business to export power (on-grid)
- Control of local electricity source (off-grid)
- Improve local energy security

When asked directly, many communities expressed an interest in developing alternative energy sources as a means to improve or protect the environment, although it was not typically the motivating factor for examining energy alternatives.

2.2 Community Energy Consumption

Energy consumption was broken down into three broad categories: Residential, Community Buildings (Non-Residential) and Transportation. Only buildings and vehicles that are owned and paid for by the First Nation or its members were included in the energy map. Buildings, such as health centres or airports which may be owned by Health Canada or provincial transportation ministries were therefore not included in the studies[1].

An “energy map” was created for each community that illustrated the energy flows through the community by source, and its resulting end uses, greenhouse gas emissions and costs. A sample energy map is shown in Figure 1 below.

The yellow arrows in the diagram show the breakdown of energy sources used in the community proportional to the amount of energy consumed. The green arrows show the community energy expenses. The blue arrows illustrate the breakdown of sector uses of the community’s energy consumption while the red arrows represent the proportion of greenhouse gases that each sector is responsible for. The maps are intended to be a concise visual of the key aspects and implications of energy use in the community and to help identify priority areas for reductions and savings.

In addition to the overall community energy maps, breakdowns of energy consumption were also completed for typical homes in the community. Figure 2 shows a sample breakdown of home energy costs. This was also done to identify and illustrate the key areas for savings to be made as

[1] In a limited number of cases these buildings were included in the energy map at the request of the band. For off-grid communities these buildings are generally included as they have significant impact on the overall supply of energy in the community.

well as to educate community members on where energy money was being spent in their homes as community member's energy expense was often a driving force for engagement in the energy planning process.

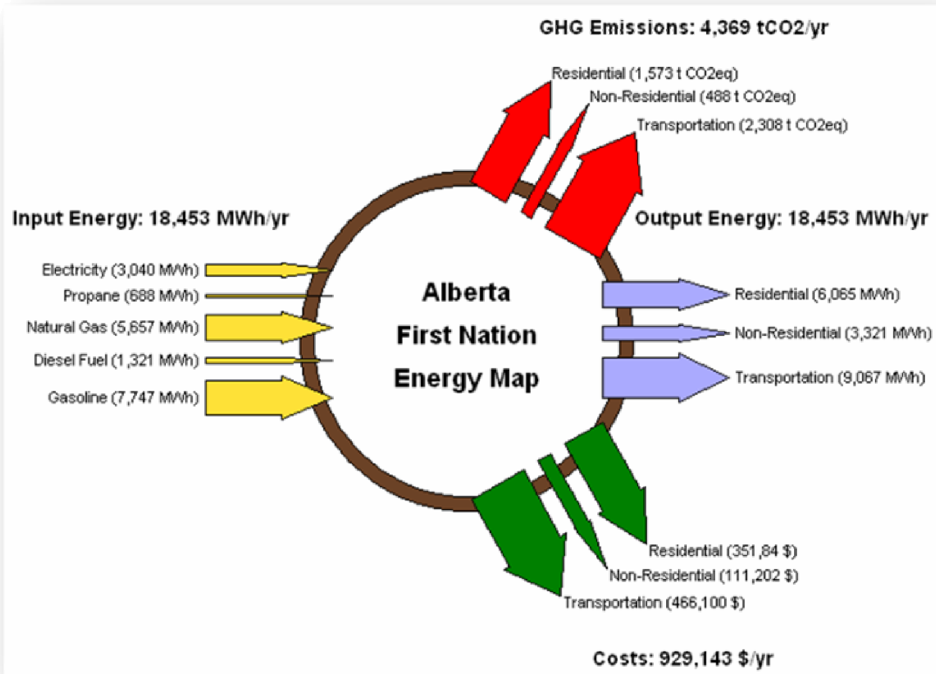


Figure 1: Sample community energy map

Home energy costs varied from region to region and community to community depending on a number of factors, most notably the fuel source used for space heating. Annual costs varied from $1,250 to $4,000, with the median annual costs close to $2,400. Communities who use wood for home heating and gather it personally had the lowest energy costs as in-kind labour was not factored into the energy costs. In many communities, it is common practice for some individuals to harvest, prepare and sell the wood, this results in higher heating costs compared to those individuals who collect solely for personal use.

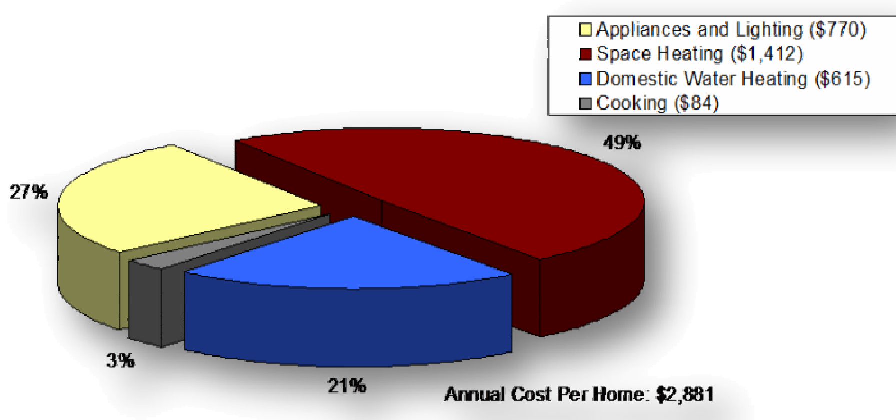


Figure 2: Typical home energy breakdown

2.3 Community Energy Options

This section outlines the common alternatives that were recommended for the community as a whole, for residential applications and for non-residential buildings such as schools and Band offices. A summary of all of the work that was completed in Alberta is shown in Figure 3, and projects that individual communities have followed up on.

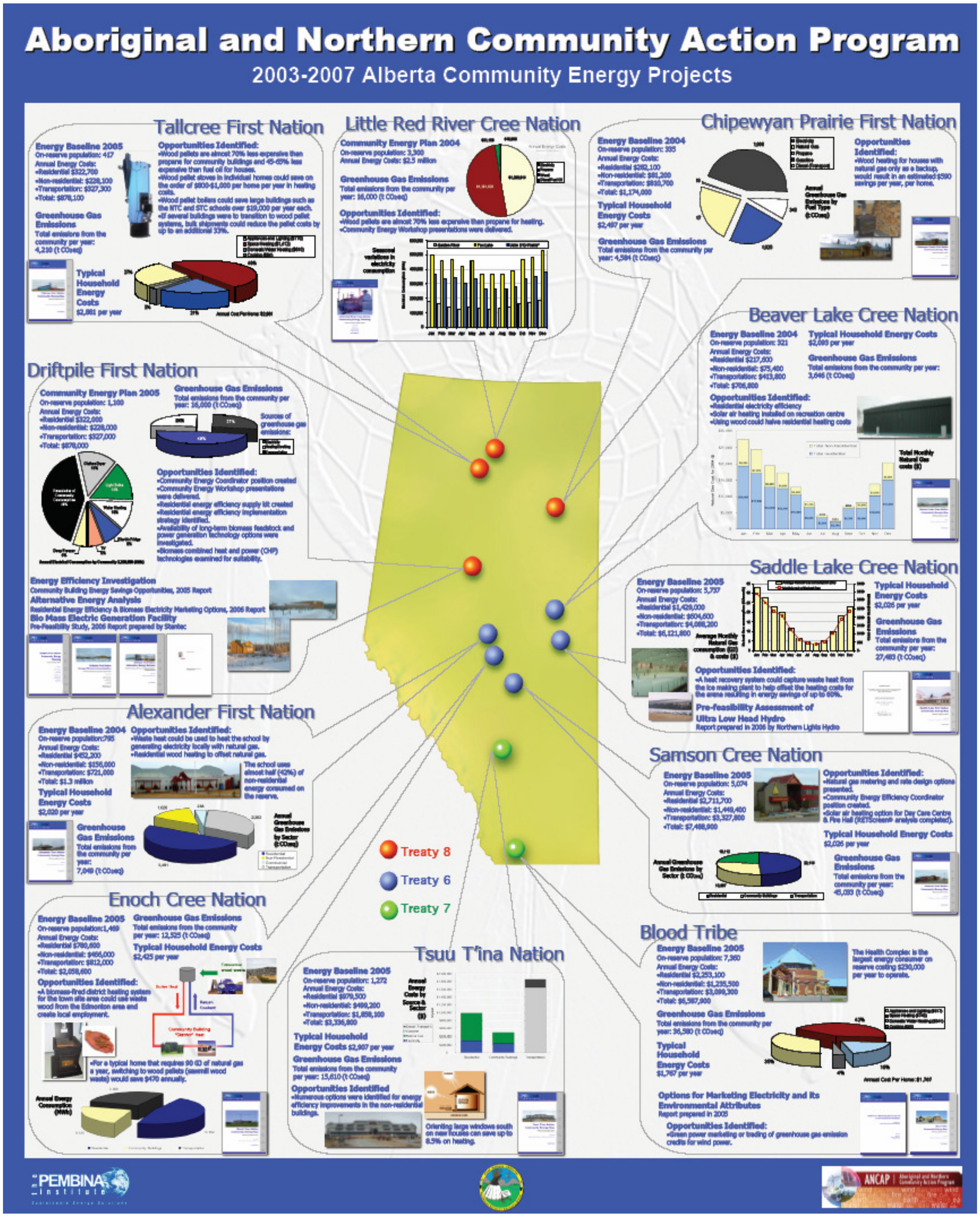


Figure 3: Summary of Work in Alberta

Similarities found while comparing different community projects are discussed below. The prices shown are nominal and would vary from location to location, particularly in remote communities, as would specific issues with respect to project development in any given location.

2.3.1 Community energy systems

1. *Combined heat and power*

Using heat that would otherwise be wasted is often the most cost effective way of reducing energy supply costs. In many remote communities there is an abundant supply of waste heat generated by diesel power plants which could be used to heat nearby buildings. In on-grid communities, large buildings that consume significant amounts of heat in the winter could use micro-turbines to also generate their own power needs. This is a very common process in industry, for example the diamond mines in the Northwest Territories all cogenerate their own heat, while the oil sands in Northern Alberta are in fact net producers of electricity. The process is much less common in the residential sector, but is equally effective.

The coolant from diesel engines can be used to heat nearby buildings.
Photo: Tim Weis

In many of the off-grid communities that the Pembina Institute completed energy baseline studies for combined heat and power systems using existing diesel plants were recommended.

Table 1 Summary of Combined Heat and Power

Capital Costs	Highly dependent on technology, fuel type and piping distances
Features	20-30 year lifespan Can more than double existing system's efficiency Captures energy already in the community
Challenges	Capital costs Location of heat source is often not close to potential loads Systems are still dependent on fossil fuels albeit much more efficient users Sale of heat can be more difficult administratively and/or legally in some jurisdictions Heat is only useful for part of the year

2. *Run-of-river hydro*

Hydro power is typically the least expensive source of electricity in Canada. Large dams benefit significantly from massive economies of scale to produce very inexpensive power although they often have significant local environmental impacts. Run-of-river systems are typically smaller but can nonetheless produce significant quantities of electricity by diverting a segment of a river's flow. In doing so, a run-of-river project does not require a dam nor result in the same level of local impacts.

Hupacasath First Nation built a run of river hydro system in 2002 to supply power on Vancouver Island.
Photo courtesy: Daniel VanVliet, INAC

A major advantage to hydro systems is that because water is a very dense liquid, they can produce large amounts of power for the relative size of plant that is built. While run-of-river systems are dependent on water levels, these tend to fluctuate less than other renewable resources such as wind, and the fluctuations that do occur are gradual and highly predictable in the short term. Hydro technology is very well established and understood, and operations and maintenance requirements are relatively straightforward.

The Pembina Institute worked closely with the Hupacasath First Nation on Vancouver Island, who successfully built a 6.2 MW hydro system that supplies power to the BC Hydro grid. The Institute also worked with Wha Ti, NWT to help the community plan for a mini-hydro system that could replace their existing diesel generators, and could even displace heating fuel. Pembina worked with Kyuquot, BC to complete a feasibility study for a 500 kW hydro plant to supply the community with renewable power and export excess to the local grid.

Table 2 Summary of Run-of-River Hydroelectricity

Capital Costs	1,500-6,000 $/kW installed Typical project costs ~ $2,500,000 for 500 kW project (off-grid) ~ $15,000,000 for a 6 MW project
Minimum Flows	0.5-12 m^3/s (for off-grid) 12 m^3/s (on-grid)
Electricity Costs	~ 5-20 ¢/kWh
Features	30-50+ year lifespan 70-80% capacity factors Stabilizes long-term electricity costs On-grid sites can often be cost competitive with grid prices and can thus be successful business ventures even without subsidies
Challenges	Access to capital costs Potential fish habitat impacts Reliability of year-round flows Negotiation of power purchase price with local utility

3. *Wind turbine (on grid)*

Many communities have been inspired by the Piikani Nation's "Weather Dancer I", the first grid-connected wind turbine built by a First Nation in Canada. Several communities that took part in the energy baseline studies began or had already begun the process of monitoring their local wind resource. The Pembina Institute put on a 1-day workshop on developing wind power projects at the Cowessess First Nation in Saskatchewan in 2006. Wind energy is often seen as an opportunity for economic development in a manner that is consistent with local land use.

A single 900 kW wind turbine is owned and operated by Piikani First Nation in partnership with EPCOR.
Photo: Tim Weis

Table 3 Summary of Grid Connected Wind Power

Capital Costs	2,100-2,500 $/kW installed Example project cost ~ $23,000,000 for 10 MW project (5 turbines)
Minimum Wind	6.5 m/s @ 80 m
Electricity Costs	~ 6-9 ¢/kWh
Features	25-year lifespan Minimal footprint Modular – can be built in phases 30-40% capacity factors typical Visual representation of commitment to sustainable energy
Challenges	Local wind quality Access to grid Waiting period up to 2 years for a turbine Access to capital Visual impacts

4. Wind-diesel hybrid (off-grid)

Kotzebue, Alaska is located above the Arctic Circle and has 17 wind turbines the first of which was installed in 1997.
Photo: John Carr, Arctic Energy Alliance

In spite of several attempts in the past, Canada has an unsuccessful track record at developing wind power to reduce diesel fuel costs in remote communities. Meanwhile Alaska has over 20 wind turbines operating in remote communities. As diesel fuel prices have risen in the past few years there has been a renewed interest in pursuing remote wind-diesel hybrid systems. In 2007 the Pembina Institute co-sponsored a wind-diesel workshop in Tuktoyaktuk, NWT to discuss wind energy opportunities in remote communities, and has worked with the Canadian Wind Energy Association to design a remote community wind energy incentive program to foster sustained long-term opportunities for remote communities.

Table 4 Summary of Wind-Diesel Hybrid Systems

Capital Costs	4,000-7,000 $/kW installed Typical project cost ~ $1,500,000 for a 300 kW project (3 turbines)
Minimum Wind	5.5 m/s @ 30 m
Electricity Costs	~ 30-75 ¢/kWh
Features	20-25 year lifespan Minimal ground surface footprint Modular – can be built in phases 20%-30% capacity factors typical Stabilizes long-term electricity costs
Challenges	Local wind quality (economically prohibitive to away from the community) Access to local distribution system Absence of government support for small wind technology Negotiation of power purchase price with local utility Access to capital Local ability to operate and maintain equipment

5. Biomass

Biomass projects require a long-term stable material supply – or ‘feedstock’, such as unused materials from a sawmill.
Photo: Larry Cumming, Peterson Pacific

Biomass systems use energy that is collected in plants or animal matter to burn as a source of heat. The Pembina Institute worked extensively with Driftpile First Nation in Northern Alberta to assist them in pursuing a biomass plant using waste wood from the logging operations in and around Lesser Slave Lake. A feasibility study was done by Stantec Engineering which found that such a system could be profitable.

Biomass systems have the advantage of not being dependent on a daily fluctuating resource such as the wind or the sun, and as a result will operate much more like a conventional power plant, making them easier to connect to the grid. However, a secure long-term biomass supply is very important to the economics of a system, and if the project is dependent on wastes from a local sawmill or farm for example, it is critical not only that a long-term supply agreement is arranged, but also that an assessment is made of the likelihood of that operation continuing to operate long-term. Biomass systems also require significant local, skilled operations and maintenance.

Table 5 Summary of Biomass Power Plants

Capital Costs	2,500-3,500 $/kW installed Typical project costs ~ $25,000,000 for 8.0 MW
Biomass Resource	6,500-9,000 tonnes per year per MW installed
Electricity Costs	~ 5-9 ¢/kWh
Features	20-30 year lifespan 70-80% capacity factors Operates predictably facilitating power purchase/grid access
Challenges	Secure long-term feedstock (biomass) supply Operations and maintenance is critical Disposal of waste ash

6. *Solar photovoltaics*

Solar photovoltaics are becoming increasingly popular as reliable electricity sources for homes and buildings
Photo: Gordon Howell, Howell-Mayhew Engineering

Solar photovoltaic (PV) panels have grown rapidly over the past 10 years, due in large part to improving technology and financial incentives in Germany, California, Japan and recently Ontario. Solar panels are modular, meaning that very small projects can be installed such as on individual homes, or larger power plant projects can be built. Smaller projects tend to be more common as individual homes and buildings use the technology to supplement/offset their own power. Prices are expected to continue to drop in the coming years, and it is likely that PV installations will become more and more economic and commonplace.

The Pembina Institute worked with the Xeni-Gwet'in First Nation in British Columbia on a community energy plan to look for alternatives to diesel. The initial research looked at small-hydro and wind energy, but the community, with the support of the provincial government, was able to develop the first PV-Diesel Mini-Grid in Canada. According to their webpage, the project "features 28kW of distributed PV resources (solar electric panels) on a remote diesel power grid. Each installed kW of PV offsets about 1MWh (or ~300L) of diesel fuel annually". "In this small off-the-shelf application more than 20% of the electricity demanded by the community is supplied by PV with an ultimate goal of 100% PV energy supply."[2]

Table 6 Summary of Solar Photovoltaics

Capital Costs	9,000-10,000 $/kW installed Typical project costs ~ $30,000 for an individual home system (3 kW)
Electricity Costs	~ 65-80 ¢/kWh
Features	30+ year lifespan No moving parts minimizes operations and maintenance costs Reliable and predictable power output year over year Modularity enables the systems to be expanded and added to easily
Challenges	High capital costs 15-20% capacity factors Unlikely to be economic without significant incentives or expensive alternatives

2 http://nemiahpower.blogspot.com/

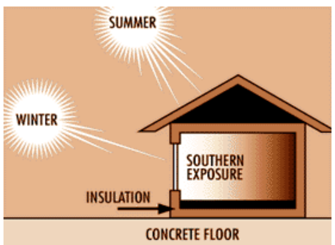
2.3.2 Building Heating Options

1. *Solar Water Heating.*

Solar water heaters can reduce hot water heating costs by 30-50% annually. Solar water heaters can be installed on homes as well as buildings that use significant amounts of hot water such as schools, hotels and laundromats. Solar hot water systems typically costs on the order of $6,000 installed and pay for themselves within 10 years in most applications – less in remote communities with elevated energy costs. Constructing new homes that are 'solar ready' adds very little to construction costs and can reduce installation costs for solar water heaters at a later date.

The Pembina Institute worked with Ecology North and the community of Wha Ti, in the Northwest Territories to install a demonstration hot water heater on the Elders Lodge
Photo: Matthew Salkeld, EnergyWise Technologies

2. *Construction to Optimize Passive Solar Heating.*



Designing communities, houses and community buildings with the largest windows facing south can maximize the amount of free energy that each building can use. This is equally important for residential and new community buildings. Properly designed awnings to keep the same windows shaded in the summer months are important to ensure buildings do not overheat or require cooling in the summer.

3. *Solarwall® Technology.*

SolarWall® technology is a low cost method to use solar energy to heat air for buildings. The application of this technology for new buildings will reduce the cost of heating buildings. The incremental cost of solar air heating is very small if it is considered early on in a project and can save thousands of dollars every year on heating costs. When added to building designs before they are built, the incremental costs can be very small, and even when added as a retrofit a solar air heating system can pay for itself in as little as 1-3 years.

The Pembina Institute worked with Beaver Lake First Nation to assist them in developing a solar air heating system for their new recreation complex, with annual estimated savings of over $7,000 per year.
Photo: Donna Lewis, Astravan Distributors

4. *High efficiency wood and pellet stoves.*

The Pembina Institute worked with Driftpile First Nation to assist in installing wood pellet heating in their Elders' Lodge.
Photo: Tim Weis

Modern high efficiency wood stoves produce fewer emissions and require less labor than traditional wood stoves. Wood pellets are manufactured by compressing sawdust and other sawmill wood wastes. Pellets are made from dry and compressed material so that they are easily combustible and leave very little residue. Because pellets are made from waste materials, they can be a low cost source of energy if purchased locally. Wood pellets can be used in houses as well as buildings such as schools and Band offices. Wood pellets were found to be economic in almost every community where they were considered, as such the Arctic Energy Alliance is developing a strategy for widespread adoption of pellet stoves across the NWT.

2.3.3 Energy Efficiency Options

Conservation and energy efficiency are always the most cost effective options to reduce energy costs in both residential and non-residential sectors. Over the course of the energy baseline studies and community energy planning projects several communities conducted various levels of efficiency analysis. Some communities made an effort to retail more energy efficient products in their local stores, while others completed sample home efficiency EnerGuide audits and other communities had more detailed audits done of specific buildings such as the Band office or the school.

While options for efficiency depend on the specific community and specific buildings in every community surveyed there were significant energy efficiency gains to be made. Common potential actions are listed below, and a more detailed list of residential ideas can be found in Appendix section 4. Equally important is the proper training of building operators and home owners to maintain and run the energy systems. In many cases, equipment such as heat recovery ventilators (HRVs) were installed in new homes, but were not run for fear of increasing electricity bills.

Common Residential Upgrades

Electricity use for appliances and lighting make up 45% of energy costs for most homes on the reserve. Reducing electricity consumption and improving energy efficiency may require buying energy-saving (*Energy Star*® rated) appliances and lighting, such as front-loading washing machines and compact fluorescent lamps, or it may mean changing consumer consumption patterns.

Energy Star® appliances often cost as little as 5% more than standard appliances, yet they typically use 10% to 20% less energy throughout the year. The small amount of extra cost up front will be returned to the user through energy savings year after year.

The international *Energy Star*® symbol is a simple way for consumers to identify products that are among the most energy-efficient on the market.

1. *Lighting*

Compact fluorescent light bulbs (CFLs) can replace standard incandescent bulbs and reduce electricity consumption by approximately 75%. In addition, the bulbs usually last 7–9 times longer than incandescent bulbs (7,000–9,000 hours are typical lifetimes for CFLs). To ensure bulb quality, *Energy Star*® labeled CFLs are recommended; these are approximately $3-7 more than traditional light bulbs.

2. *Hot Water Tank Insulation*

A simple way to reduce water-heating costs is to insulate the water tank with an insulating blanket that wraps around the tank. These blankets can cost as little as $35 and can save the same amount in electricity costs per year. The best way to reduce water heating costs however is to use less hot water.

3. *Water Conservation*

While individuals do not pay for water on most Reserves, there is a significant community cost involved in pumping, treating and disposing of water to the homes in the community. Reducing hot water saves heating costs as well as the overall community costs, but reducing cold water consumption is also beneficial to the community as a whole as it reduces the burden on municipal water and wastewater treatment systems, as well as pumping costs.

Showers and baths, toilet flushing and laundry are the most significant water using activities in most homes. Simple measures to reduce water use in the home include low-flow faucet aerators and volume displacement containers placed in toilet tanks.

4. *Low Flow Showerheads*

Showering is usually the largest single use of hot water in a home and can account for 10%–15% of total energy use in the home. Old style showerheads use 3 or even 4 gallons per minute (gpm). Newer models typically use 2.5 or 2.2 gpm, and super low-flow showerheads use only 1.75 gpm.

5. *Front-Loading Clothes Washers*

Front-loading washing machines have been used for decades in Europe and are rapidly being adopted in Canada. They use approximately half the amount of water and soap of a top-loading washer. Thanks to much higher spinning speeds, they also extract more moisture from clothing, resulting in reduced dryer time. An additional benefit is that front-loading (or horizontal axis) tumbling action is much gentler on clothing fabric. Although difficult to quantify, this results in reduced replacement costs for clothing.

New front-loading washers use three to four times less energy than new top-loading models and can save as much as $200 per year in energy costs.

6. *Faucet Aerators and Toilet Dams*

Faucet aerators can be placed on all sinks in the home and operate on the same principle as the low-flow shower heads while they cost on the order of $2.00-$3.00. Toilet displacement devices cost approximately $5.00 and save 3-5 L per flush. A brick or even a rock in the toilet tank will have the same affect.

Common Non-Residential Efficiency Upgrades

1. *Fluorescent T8 with Electronic Ballast*

Replacing existing T-12 lamps and ballasts with T-8 lamps and electronic ballasts reduces the connected lighting load for a two-lamp fixture from 82 watts to 59 watts, which represents a savings of 16%. Alternatively, electronic ballasts with a low ballast factor (0.77) further reduce the connected lighting load to 51 watts per fixture, resulting in a 27% savings and provides the same, not higher, light levels as the original T-12 installation.

2. *LED Exit Lights*

Light emitting diode (LED) exit lights consume only 3 watts of power compared with 40 watts or more for incandescent exit lights. Payback can be as little as less than one year in remote communities and up to 5 in on-grid applications.

3. Occupancy Sensors in Offices

Occupancy sensors can be ceiling mounted, centrally controlled or integrated into a light switch. These sensors are ideal for areas of intermittent occupancy such as meeting rooms, conference rooms, coffee rooms and offices. Lights automatically turn on when someone enters the room and turn off after the occupants leave (after a delay period that can be customized for each area). Savings result from the reduced operation of the lighting system. Payback varies, but 3–5 years is typical.

4. Building Weather Stripping

The weatherstripping of doors and windows, and the sealing of vents and dampers are both very important for several reasons. Tightly sealed vents, doors or windows allow less cold air to enter the building; fresh air will enter the building only through controlled means such as the air handling system. Also, it is easier to maintain a proper static pressure control. In winter, poorly sealed dampers, doors and windows greatly affect heating. By maintaining and replacing worn weatherstripping, heating savings as large as 25% can be realized.

Small air leaks are not always visible, but their combined impact on heating costs can be significant. It is often easiest to find drafts on cold windy days – doing a tour of any building to check for drafts around windows, doors and vents will identify places where a small amount of maintenance (caulking, weatherstripping, spray-foam insulation, etc) can have a large and immediate effect on heating bills as even small cracks can be the same as having the window open in the winter.

5. Equipment timing

Frequently pumps, exhaust fans and other mechanical systems are set to run continuously but may only be needed during working hours or when buildings are operated. Checking schedules and installing or re-programming timers can add up to significant savings, while increasing the working lives of the equipment involved.

3 Conclusions

3.1 Summary of Findings

While each community has its own unique characteristics, challenges and opportunities, there were key findings that were common across many of the energy baseline studies. Energy costs (on per house and per person basis) are consistently higher in Aboriginal communities than in non-native communities or when compared to provincial averages. This in part has to do with being located often in rural parts of the country which often have higher energy rates, but is also a result of building overcrowding, mechanical system disrepair and low levels of energy efficiency technologies, notably insulation. In many cases higher energy use is also a result of a lack of resources and capacity for building and home maintenance and upkeep.

Housing typically represented the largest energy consumption, costs and opportunity for savings. Rapidly growing, young communities often strain housing budgets leaving the leadership to frequently opt to build numerous lower quality homes such as trailers, as opposed to investing additional funds into more energy efficient housing stock. Lower quality homes not only consume more energy during their normal operation, but were also more likely to deteriorate more quickly due to moisture and weather. Minimum standards of construction would help alleviate some of these issues as well as proper training in home maintenance. A successful example was Beaver Lake Cree Nation in Northern Alberta who required home owners to take a brief home maintenance course before the Band would provide any retrofit or repair funds.

The wide spread in home energy use that is common in many communities is illustrated in Figure 4 below which illustrates the annual electricity consumption in homes in a particular community. This is in part due to the state of repair of some homes, as well as individual energy choices and awareness of costs.

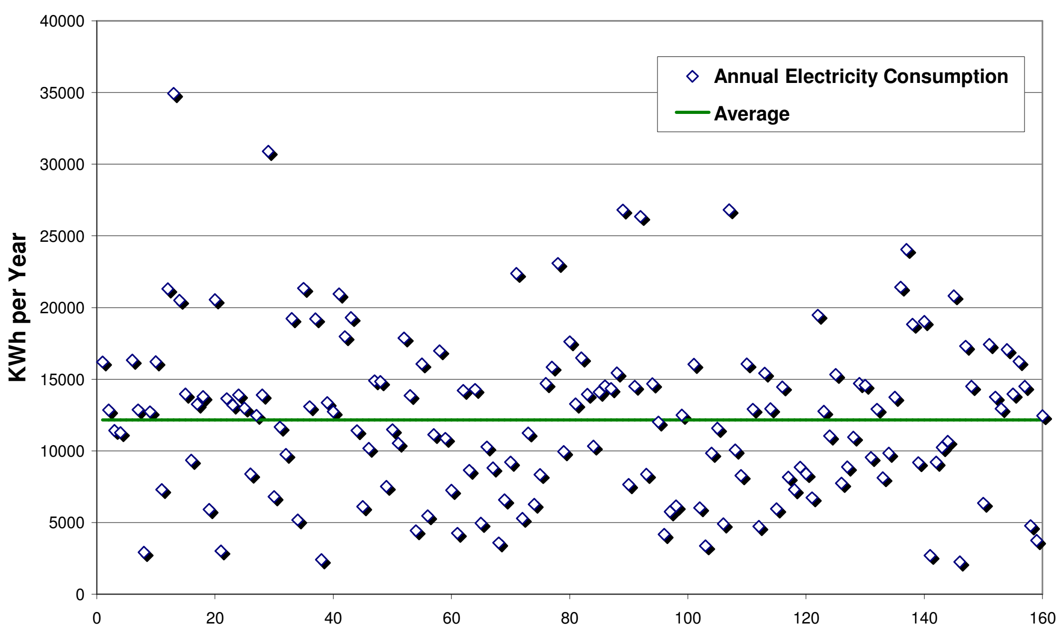


Figure 4: Typical spread in household annual electricity use in a community (by house number)

Without exception, there are significant opportunities for very low cost energy efficiency and conservation measures that can result in significant energy and cost savings in both the residential and non-residential sector. The simple payback on many of these upgrades is within 3 years and many less than 1 year. In off-grid communities, even more projects have very rapid simple-payback periods. *Effective* energy awareness projects throughout the community may result in decreased energy use, along with feedbacks for accruing the benefits of energy savings. Frequently, the uptake and impact appears to be limited in many cases of similar programs in the past in part due to a lack of benefits to individuals for making reductions.

Community planning and integration around infrastructure decisions, capital projects and operations could lead to significant savings. Examples include planning community housing for proper solar orientation (passive heating, solar hot water and photovoltaics), while remote communities stand to make significant savings by taking advantage of waste heat from diesel power plants into district heating systems.

While transportation was consistently identified as major cost and source of emissions, there was very little appetite for or obvious solutions available to reduce consumption beyond encouraging the purchase of more fuel efficient cars and trucks, and improving driver habits (eliminating idling, reducing highway speeds, etc). These challenges are common to all rural communities in Canada, including non-native communities.

3.2 Keys to Success

Since the Institute has been undertaking this work, it has observed a steady and increasing interest in communities to look for energy alternatives to reduce energy costs for community members and for band buildings. Many communities were motivated by neighbouring communities who had also begun to pursue alternatives. Environmental considerations and benefit of developing projects were important but tended to be secondary considerations for communities who were generally interested in renewable energy projects to reduce local costs or as a means of local economic development.

In every community, there was at least one and usually more opportunities for some type of alternative, locally appropriate energy project. Many of community studies have resulted in alternative energy projects, while others have not been successful in finding new solutions.

Projects that have been successful have largely been due to a high level of community participation, leadership and long-term involvement. Other important issues include simply having a harvestable resource locally, the timing of available funds and other technical issues such as access to local power grids.

Most of the energy baseline studies were intended to simply provide communities with a snapshot of the energy they were using and its economic and environmental costs. The budget allocated to such projects was insufficient to enable long-term follow-up on the potential options and alternatives that were identified. Furthermore, many of the baseline projects were initiated either regionally or federally and did not have significant buy-in from the participating community as to how the project connected with overall community issues.

3.3 Barriers to Action

In spite of the significant interest in reducing costs and developing alternatives in aboriginal communities there remain a number of barriers to this development. The extent to which a barrier may or may not apply is community specific, but common issues are discussed here.

3.3.1 Funding

Many Aboriginal communities, like most towns or villages have limited access to capital that is not already in need for other community projects and upgrades. Accessing the capital required for large energy projects therefore depends heavily on government support or the ability to attract an outside partner.

There are numerous programs that exist for Aboriginal communities predominating through INAC, either directly as was the case of the Aboriginal and Northern Community Action Program (ANCAP) or indirectly through Aboriginal Business Canada (ABC). These programs can be of great assistance to projects, but can also cause significant problems. Uncertainty in funding procedures and decisions can cause significant delays in projects, particularly when seasonal issues may delay programs such as resource monitoring.

There is a wide variety of funding windows to different agencies and various levels of decision making, very little of which is done by the community itself and more often “for” the community by program managers. These programs are also often limited to their specific mandates, examples of which are the ANCAP which could not fund residential projects, or its predecessor the Aboriginal and Northern Climate Change Program that could not fund capital purchases.

Programs that do allow for capital purchases are often only very small amounts relative to the overall project costs, with the intent being to leverage investment. This model is limited in cases where there are no commercial partners and communities who have limited ability to raise funds from traditional lending sources.

3.3.2 Institutional

Many of the important energy decisions in the communities are as a result of designs within the “built environment” i.e. housing and community buildings. There is often no link between the capital cost of a building and its operating costs, and the respective departments funding them, and therefore no upstream, nor downstream link or incentive exists to encourage energy efficient design and training.

In many cases communities are able to receive funding to cover energy needs in the community. However, if energy savings are made in one area, such as education for example, they may not be transferable to other departments within the community. Other times energy savings will result in reduced funding. While there are rightfully emergency funds available for energy crises such as failed winter roads, the same level of funding is not available for alternative energy solutions that would avoid or minimize such emergencies.

Finally, in many communities a local business is established to supply the current energy services, an example would be in remote communities where local agencies import the diesel fuel and sell it to the local power provider. In such cases, these businesses have vested interests in not seeking alternatives.

3.3.3 Human Capacity

Energy projects are long-term projects and at times can be complex. It is important for a “project champion” to emerge from within the community who will see a project through to completion by persistently completing the necessary steps such as fundraising, obtaining community buy-in, completing local permits as well as other project management steps. Not having the human resources to dedicate to an uncertain project can severely impede its process.

In addition two-year election cycles for chief and council can disrupt progress as new leaders may have different priorities or require time to understand project benefits and history.

Resource data collection takes at least a year to complete and often more. Having consistent local personnel to collect data and monitor remote sensing equipment is important to collect high quality data and avoid gaps, but can be difficult as individuals move in and out of the community.

4 Appendix

Here is a list of things that you can do in order to use less energy that will save you money and help protect the environment. It all adds up, so the more you do, the more money you can save.

Free—Things That Cost Nothing and Save Cash

- Turn down water heater thermostat to 120°F (49°C).
- Turn off lights when leaving a room.
- Set thermostats to 68°F (20°C) in winter when you're home, and down to 55°F (13°C) when you go to bed or when you're away. (Programmable thermostats do this automatically—see below).
- Use energy-saving settings on washing machines, clothes dryers, dishwashers, and refrigerators.
- Don't waste water, hot or cold, inside or outside your home.
- Clean your refrigerator's condenser coils once a year.
- Air-dry (hang) your clothes – especially easy in the summer.
- Close heating vents in unused rooms.
- Repair leaky faucets and toilets (5 percent of water "use" is leakage).
- Close drapes after sunset and open them to sunny weather for heat and lighting.

Simple and Inexpensive—Things That Will Pay for Themselves in Lower Energy Bills in Less Than a Year

- Install a water-saving 2.5-gallon-per-minute showerhead ($15).
- Install water-efficient faucet heads for your kitchen and bathroom sinks ($5 each).
- Install a programmable thermostat ($30).
- In the attic and basement, plug the air leaks a cat could crawl through, and replace and reputty broken window panes ($25).
- Clean or change the air filter on your warm-air heating system during winter and on air conditioning units in the summer ($0-$5).
- Install an R-7 or R-11 hot water tank wrap ($15).
- Insulate the first three feet of hot and inlet cold water pipes ($6).
- Install a compact fluorescent light bulb in the fixtures you use the most ($3/bulb).

Getting Serious—Measures That Collectively Will Cost Up to $500 and Have Paybacks of One to Three Years

- Get a comprehensive energy audit, including a blower door test, to identify sources of air infiltration.
- Caulk and weatherize all leaks identified by the test. Start with the attic and basement first (especially around plumbing and electrical penetrations, and around the framing that rests on the foundation), then weatherize windows and doors. Additional fresh air ventilation and moisture control may be needed.
- If you are replacing your clothes washer, dishwasher, or refrigerator look for new energy efficient machines – they use up to 75% less energy and although they cost more, will

pay for themselves in electricity savings within a few years.
- Seal and insulate warm-air heating ducts.
- Have heating and cooling systems tuned up every year or two.
- Install additional faucet aerators, efficient showerheads, and programmable thermostats.
- Make insulating shades for your windows, or add insulating storm windows (or, in a southern climate, shade sunny windows or add solar gain control films).
- Insulate hot water pipes in unheated basements or crawlspaces.

Going All the Way—Measures That Will Save a Lot of Energy and Money, But Will Take Three to Fifteen Years to Pay for Themselves

- Foundation: insulate inside rim joist and down the foundation wall to below frostline to *at least* R-19 in cold climates and to R-11 or better in moderate climates. Remember to caulk first.
- Basement: insulate the ceiling above crawlspaces or unheated basements to at least R-11. If your basement is heated, insulate the inside of basement walls instead to R-19 or more above grade and to R-11 or more below grade.
- Attic: increase attic insulation to R-38 in milder climates.
- Walls: adding wall insulation is more difficult and expensive, but may be cost-effective if your house is uncomfortable.
- Install more compact fluorescent bulbs. Put them in your most frequently used fixtures, including those outdoors.
- Replace exterior incandescent lights with compact fluorescents and put them on a timer or motion sensor if they're on more than a couple of hours a night.
- Install a radiant barrier in your attic if your home is prone to overheating in the summer.
- Upgrade your water heater, furnace, boiler, air conditioners, and refrigerator to more efficient models. Newer units are far more efficient. Upgrading is often cost-effective, and definitely so if you need to replace failing units anyway. Also, if you've weatherized and insulated, you'll be able to downsize the heating system.
- Upgrade to superinsulating or at least low-emissivity windows in cold climates, if replacement is needed.
- Replace high-flow toilets with modern water-efficient toilets that use 50–80 percent less water.
- Install awnings or build removable trellises over windows that overheat your home in the summer.
- Plant a tree to shade your largest west window in summer. You won't save any money for years, but you'll get an A+ for long-range vision.
- Add solar water heating, and perhaps also supplementary solar space heating.

About the Pembina Institute

The Pembina Institute creates sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. More information about the Pembina Institute is available at www.pembina.org or by contacting info@pembina.org

About the Authors

Tim Weis, M.Sc., P.Eng.

TIM WEIS is a senior technical and policy analyst who has focused his technical research with the Pembina Institute on renewable energy. Tim has co-authored numerous reports and manuals on renewable energy development in First Nations communities. He has developed software to complete community energy baseline inventories and has assisted more than 20 communities at various stages of development of renewable energy projects. Tim is also currently completing his PhD at the Université du Québec à Rimouski where he studies wind energy development in remote Canadian communities. Tim has a Master of Mechanical Engineering degree where he studied ice adhesion to wind turbine blades.

Paul Cobb, B.Eng.

PAUL COBB is a Technical and Policy Advisor with the Pembina Institute's Sustainable Communities Group. Paul leads the Pembina Institute's international program, which is aimed at expanding sustainable livelihood opportunities through increased access to clean, reliable and renewable energy. He has worked with partners in developing countries to build capacity in the areas of renewable energy technologies, climate change and carbon financing. Paul also works with municipalities and First Nation communities in Canada to develop energy baseline inventories and complete energy efficiency and renewable energy implementation plans. In addition, Paul provides technical support and policy research relating to renewable energy, energy efficiency and carbon capture and storage technologies. Paul has a degree in Mechanical Engineering from McGill University.

Acknowledgements

The Pembina Institute gratefully acknowledges the support of Conoco Phillips who provided the financial resources to compile and publish this summary.