Barriers to the Implementation of Renewable Energy Systems in Remote First Nation Communities

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1. Introduction

In Canada there are over 300 remote communities with a population of about 200,000. Many of these are isolated First Nation communities that are not connected to a central electricity grid or natural gas network. These communities are characterized by a high dependence of imported oil and have energy costs that can be up to 10 times higher than the rest Canada.[1] In most of these communities, electricity is produced on isolated diesel grids by generators operated and maintained by either provincial electric utilities or Indian and Northern Affairs Canada.

Diesel-generated electricity in remote areas of Canada produces about 200,000 tons of greenhouse gas (GHG) emissions every year[2] and also releases other pollutants into the air. Climate change is already having an impact on those communities that depend on traditional lifestyles. Winter ice roads that supply communities have shorter seasons. Permafrost is degrading and slumping. Wildlife migration patterns are changing and their associated resources are less predictable. A significant proportion of these emissions could be reduced by switching to clean and renewable sources of energy, such as small hydro, small wind and solar photovoltaics.

Although these renewable energy resources are readily available, few remote First Nation communities have taken full advantage of them to meet their electricity and

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[1] Ah-You and Leng
[2] Climate Change Solutions

heating needs. There are a number of barriers which inhibit remote First Nation communities from implementing renewable energy systems (RES). However the most significant barrier is the inability of these communities and the government to access capital markets. To begin, this paper will review two RES which are competitive with diesel generation as well as the existing opportunities for implementing such systems. Next, the barriers to implementing renewable energy technologies will be examined, followed by three case studies in which these barriers were overcome. In conclusion, this paper finds that in order for remote First Nation communities to implement RES, they must be provided with access to capital markets. This access could be provided using pollution offsets under a tradable permits system.

2. Options for Renewable Energy Systems

The current system of diesel generation of electricity is very expensive due to the high cost of oil. Moreover, the price of oil can fluctuate greatly meaning that the cost of diesel generation can be highly unpredictable. By implementing a renewable energy system communities will no longer be subject to the high price of diesel and will have greater price stability. Also, unlike diesel systems which are owned by the government, remote communities that own a renewable energy system have an opportunity to make a profit from the sale of any excess electricity produced to outside purchasers.

Low impact renewable energy is defined as "Non-fossil fuel energy sources that are replenished through the earth's natural cycles and have a minimal impact on the environment and human health."[3] Canada has extensive low impact renewable energy including solar, wind, small-scale hydro (including run-of-the-river), biomass and earth

energy. These resources can be used with little or no impact on the climate and by displacing conventional energy sources reduce the amount of GHG's in the atmosphere. Most renewable energy sources have very low, or virtually no fuel costs and are therefore essentially inflation proof. By contrast, non-renewable fossil fuel energy sources, such as coal, oil and natural gas, are the key contributors to global climate change and have very high, fluctuating costs. Among the many renewable energy systems available to First Nations, there are two which are presently economically competitive with diesel generation: small-scale hydro and hybrid wind-diesel.

By replacing expensive diesel generation in remote communities with small-scale hydro power, Canada will benefit a great deal from the associated cost savings. "Public electric utilities in Canada are required to provide electric service to isolated communities so that such utilities in several of the provinces are encouraging…new developments of small hydro to substitute for diesel power in remote communities."[4] In Canada 'small' hydropower can refer to upper limit capacities of between 20 and 25 MW; however, a value of up to 10 MW total capacity is becoming generally accepted.[5]

Although the potential for small hydro-electric systems depends on the availability of suitable water flow, where the resource exists it can provide cheap, clean reliable electricity. A well designed small hydropower system can blend with its surrounding, especially 'run of the river' configurations, and have a minimal effect on the

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[3] Canadian Association for Renewable Energies
[4] International Small Hydro Atlas
[5] Ibid

environment. The economics of a site depends on the power capacity, if the power can be sold, and the price paid for the power sold. Generally, the capital costs of small hydro projects range between $1,500-7,000 / kW which is translated into an energy cost of about $0.05 – 0.20 / kWh. Maintenance costs are $0.015 / kWh. The payback period, or the amount of time such a project takes to pay itself off, is anywhere from 10 to 40 years.[6]

One of the most significant near-term markets for wind energy in Canada is in small remote communities, mostly in Northern Canada, that are far from the existing utility grid. Wind-diesel is the generic term given to energy supply systems that combine diesel powered electrical generators, which provide prime power, and wind turbines, which operate when wind power is available to reduce the load on the diesel generators and displace diesel fuel. Wind-diesel projects in remote northern Canadian and Alaskan locations have demonstrated that wind energy can reduce the high costs associated with transporting diesel fuel to these remote sites. As wind energy is supplied into the grid, the energy required from the diesel plant is reduced and less fuel is consumed. For low levels of wind power supply, there is virtually no impact on the diesel plant operation and total fuel savings are limited. In contrast, if the wind plant is supplying high quantities of electricity, it may be possible to shut down the diesel generators for many hours of the year. The economics of wind-diesel systems are highly site specific. Generally, capital costs are in the range of $1000 – 4000 / kW, translating into an energy cost of $0.05 – 0.20 / kWh. The payback period for wind projects can vary from 5 to 15 years.[7]

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[6] Alward (2003)
[7] Ibid

Besides the obvious economic benefits, there are also a number of social and environmental benefits associated with RES. First, in all communities, but especially the ones that are remote, it is important to have a reliable and adequate source of energy. Sole reliance on diesel generators can leave theses communities stranded if the generator malfunctions or if the demand becomes too great. Renewable energy systems can provide a greater sense of security through diversification of the energy supply and can help meet the increasing demand of rapidly growing communities. Second, implementing a renewable energy system requires dedicated staff that can be trained in the maintenance and upkeep of such a system. There is therefore the potential to create job opportunities not only from the construction of the system but also from the ongoing maintenance and operation requirements. Third, since renewable energy is usually cheaper than diesel, the cost savings can be invested in other infrastructure or community programs.

Finally, the use of diesel generators poses a significant threat to the environment and to the health of human beings. The transportation and handling of diesel fuel and the use of cheap, poor quality holding tanks put the community at risk for spills and the contamination of local groundwater.[8] The burning of diesel fuel releases GHG's and many other harmful air pollutants into the atmosphere. These emissions lead to climate change and air pollution problems such as smog and acid rain. By switching to a renewable energy system, the use of diesel fuel can be significantly reduced, leading to a reduction in the risk of spills and contamination of groundwater and to the reduction of GHGs and local air pollution.

[8] Environment Canada, Storage Tank Systems for Petroleum and Petroleum Allied Products

3. Existing Opportunities for Implementing Renewable Energy

3.1 Indian and Northern Affairs Canada

In Action Plan 2000, the Government of Canada announced the $3.7 M Aboriginal and Northern Climate Change Program (ANCCP) which operated from 2001 to 2003.[9] Many opportunities to reduce GHG emissions in these communities were identified and a high level of awareness and interest on energy use and production was generated.

Building on the positive two year experience, in August 2003, the Government of Canada announced new funding totaling approximately $30.7 M over 4 years for initiatives to be taken related to Aboriginal and northern communities with resources allocated to and under the direction and management of the Department of Indian and Northern Affairs Canada (INAC), in partnership with Natural Resources Canada (NRCan). This new measure, the Aboriginal and Northern Community Action Plan (ANCAP), is focused on engaging Aboriginal and northern communities in all provinces and territories to become active partners in climate change action.[10]

3.2 Eco-Action

The Eco-Action program is administered by Environment Canada and is used to fund projects that have a "measurable, positive impact on the environment". To be eligible, projects must "encourage community action and awareness, respond to community needs, and obtain matching funding or in-kind support from other sponsors." First Nation councils, amongst other groups, are eligible to apply. Priority for funding is

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[9] Government of Canada Action Plan 2000 on Climate Change

[10] Government of Canada Climate Change Plan for Canada, 2003

given to projects that will achieve results in the following areas: clean air and climate change, clean water, and nature.[11]

3.3 Cooperatives

There are about 133 co-operatives in Canada, in which the membership is predominantly Aboriginal, which make substantial economic contributions to the communities they serve through local businesses and through the wholesales they own, which return surpluses or profits back to them. The co-operative model extends ownership and control to the people who are involved in it as members and offers an alternative to First Nation leaders who are looking for an economic development model that takes into account history, collective aspirations, economic diversity and is responsive to the community. First Nation co-operatives have been successful in serving a wide variety of needs, the most common being the provision of food and supplies in remote communities.[12]

There are a number of cooperative across Canada which have been established to develop renewable energy projects. Two such cooperatives are WindShare[13] and TREC North[14], both aimed at building power generating wind turbines within their communities. Similar cooperatives could potentially be developed within First Nations and is definitely an option that should be investigated further.

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[11] Environment Canada, EcoAction
[12] Canada. Co-operatives Secretariat
[13] Toronto Renewable Energy Co-operative, 2004.
[14] Temagami Co-operative Wind Farm Project, 2004. For more information please contact Robin Hughes or Anna Gibson at TRECNorth@onlink.net.

3.4 Pathfinders

The Aboriginal and Northern Climate Change Program, jointly funded by Natural Resources Canada and Indian and Northern Affairs Canada, initiated prototype Energy

Pathfinder projects in two regions of the country, northwestern Ontario and Alberta. The goals and objective of a pathfinder are to identify renewable energy projects, to educate of such projects. The pathfinder also helps communities find financial resources and assists them with policies, procedures and environmental law. The pathfinder provides this people on such projects, to build capacity, and to help in the planning and implementation information and assistance through workshops, the development of training materials and the training of technical groups within the community. Pathfinders such as this are important instruments in breaking the informational barriers that first nations often encounter.[15]

4. Barriers to the Implementation of Renewable Energy Systems

Although there are significant benefits as well as a growing number of opportunities in implementing RES, such systems are still very much uncommon throughout First Nation communities. Some of the barriers that First Nations face in implementing RES involve informational barriers, human resources, institutional structure, financing and public policy.

4.1 Informational and Human Resources

[15] First Nations Technical Services Advisory Group (2002)

Informational barriers exist at both the government and community levels. At the government level there may be inadequate staff with the proper training and expertise required to deal with renewable energy and First Nation issues. At the community level, households and the local government may often be unaware of the issues at hand and may not have access to resources that can help them become more familiar with the importance and benefits of RES or of the options available to them.

Maintenance and operation of the RES requires that there be experienced, knowledgeable staff in the communities. Most communities do not have individuals with the necessary qualifications. Therefore it would be necessary to provide appropriate training.

4.2 Institutional

Unlike most levels of governments in Canada, First Nation governments do not have an independent source of revenue. Rather, it is the federal government which collects taxes on First Nation lands. As a result, First Nations rely heavily on government transfers as a source of revenue. Therefore the ability to provide services and to build infrastructure in their own communities is very limited. The Assembly of First Nations (AFN) finds that "the fiscal relationship for First Nations is deeply flawed. First Nation governments have no access to long term capital markets. Most taxes collected on First Nation lands are collected by other governments. Comparable government service quality and infrastructure on First Nation lands is an ongoing issue."[16]

The extent of the financial barriers First Nations face is therefore significantly dependent on the actions or inactions of INAC. Indian and Northern Affairs Canada

[16] Assembly of First Nations

controls the amount of transfers these communities receive and in most cases the manner in which these transfers are spent. All available housing and reserve land are owned by the Crown meaning that individuals do not own their own land or homes and therefore do not have any equity. Since there is no ownership on reserves there is no collateral to get financing for economic development. Since they are high risk, this makes it very difficult for communities to obtain loans to finance projects and the financial institutions that do give loans are at a rate 3 to 4 percent higher than average.[17] It is therefore very difficult for communities to find a project that is profitable at these rates.

First Nations would definitely like to see renewable energy systems being used in their communities. The problem, according to Robin Huges,[18] is that First Nations have many urgent issues to consider. Unfortunately implementing a renewable energy system often takes a back seat to other important issues such as housing, healthcare and education. A lot of First Nation governments' time is spent lobbying Canadian governments to increase funding. Once their peoples basic needs are met, they will be able to focus more of their time and resources on such issues as energy efficiency and RES.

4.3 Capital Costs

Renewable energy systems are typically characterized by high capital costs and planning compared to that of diesel generators. Prior to constructing a RES, feasibility studies and environmental assessments must be carried out at both the federal and

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[17] Personal conversation with Robin Hughes, Mar. 23, 2004. Robin Huges is currently the owner and president of Practical Northern Solutions. In the past he has been an energy advisor for NRCAN and INAC, and has served as a Pathfinder for the Northern Chiefs and Ogee Cree.

[18] Ibid

provincial levels which can take up to 2 or 3 years. Construction permits must be obtained and archaeologists must be brought in to look at the immediate site.[19]

Although the engineering and construction costs are the same in all communities across Canada, the remoteness of these communities increases the costs significantly. Most communities can only be reached by either an ice road, which is typically available for six weeks of the year, or by air. This makes it costly to bring materials into the construction site as all material and equipment must be brought in during the six week window and whatever cannot be moved during this time must be flown over in pieces and then reassembled on site. In communities that can only be reached by air it is even more difficult and costly to bring in heavy equipment. Poor accessibility not only affects getting equipment in but also getting it back out. Even if the project is completed the equipment may be trapped there if the completion date is not within the six week window. This is costly as it ties up capital which could be used elsewhere.[20]

In addition, the accommodation costs for construction workers and project managers are significantly higher since there are no hotels on site. Accommodations can be acquired by either renting or sharing a house. On occasion staff houses are built for accommodation purposes but are rented out at fairly steep prices. Over the construction period these projects can become quite expensive and generally range in the millions of dollars.[21]

4.4 Public Policy

[19] Ibid
[20] Hughes, Robin
[21] Ibid

As in most of Canada, electricity in remote communities is subsidized by the government. Typically a community that has its own private utility will pay about $.25 per kWh. If the community does not have a private utility, it will hire a provincial utility to look after the generation, transmission and maintenance duties, for which it pays about $0.10 per kWh. Both of these rates are heavily subsidized by the government. The true cost of providing the electricity is actually much higher, somewhere between $0.50 – 0.80 / kWh.[22]

The question then is, if INAC faces the true cost of providing electricity why would they not take advantage of the opportunity to build RES's which are considerably cheaper? There are two plausible explanations. The first is that there is significant institutional momentum within government that continues to favour traditional energy sources over renewables, despite strong economic, environmental and health arguments to the contrary. Since RES technologies are relatively new, there is significant market inertia favouring traditional energy sources in terms of investor comfort, utility expertise, market structures, and energy delivery infrastructures.

The second is government budget conventions. Governments do not presently distinguish between an operating (or current) budget and a capital budget. Therefore, capital investments must be made from a single annual budget which is funded through either taxes or deficit.[23] In contrast, with a distinct capital budget, the government would borrow to finance the investment. The government's balance sheet would show both an increase in assets reflecting the value of the RES and an increase in liabilities reflecting the borrowed capital. The government's operating budget would immediately improve as

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[22] Hughes, Robin

[23] See Starrett, pg.112-113 (1988) for a discussion.

a result of the investment since it would now be paying less per unit of energy (which includes the cost of interest and depreciation).

The current political atmosphere is such that voters do not want the government to run a deficit and they want lower taxes. In this situation capital expenditures and current priorities are in direct competition for tax dollars. As a result, fewer proposals for

capital expenditures are approved, since they would require sacrificing spending on current priorities. Since the government is not willing to tap private savings to fund capital expenditures, the result is inefficient public policy – in particular, high cost electricity that is also very polluting.

5. Successful Renewable Energy System Projects

5.1 Deer Lake First Nation

Deer Lake First Nation is located in Northern Ontario and has a population of 830. The community can be accessed by a winter road from January through March and by air year round. Like most other remote communities, electricity was supplied, until recently, by a diesel generator grid. In 1998 a run-of-the-river hydroelectric plant was implemented through a partnership between Hydro One Remote Communities Inc. and Deer Lake First Nation. In 1999 the hydroelectric plant was completed with construction costs totaling $5.8 M. Hydro One agreed to fund the project in an effort to increase the amount of green energy it produced while reducing its cost of using diesel fuel. INAC funded about $1 M of the construction cost, the approximate amount it would have cost to upgrade the diesel generator. In developing a renewable energy system, the community wanted to increase employment, improve their skills and become more self-sufficient. As a result of the project, the community increased their permanent employment positions as well as temporary construction jobs. During 1999-2000, the project reduced diesel fuel use by over 30%, while still producing the same amount of energy for the community. Reductions were expected to increase to 50% by the end of 2001. Deer Lake now saves approximately 400,000 L of fuel per year at a cost savings

of $350,000. They have also reduced their annual emissions of SO_2 and NO_x by 25.5 tonnes and 2.5 tonnes respectively as well as reducing their CO_2 emissions by 1300 tonnes. Deer Lake will acquire full ownership of the plant by 2009 at which time any profits generated by the plant will accrue to the community.[24]

5.2 Rankin Inlet

Rankin Inlet is located in Nunavut, on the shores of Hudson's Bay, and is a community of approximately 2000 individuals. The community depended on an isolated grid of diesel generations sets which were fueled 3 to 4 times a year. Due to the high price of diesel and the location of the community (good winds), they were a good candidate for a hybrid wind/diesel generation system. In September 2000 NWT Power Corp. completed the construction of a 50 kW wind turbine which was connected to the local diesel grid. The capital cost of the project was $340,000 with an annual maintenance cost of $8,000. The wind turbine now generates 80,000 kWh and displaces

[24] Alward (2003)

run-of-the-river hydroelectric generating system was installed at the lodge in 1992 to replace a 12 kW diesel generator. The micro-hydro system now supplies almost all of the energy requirements of the lodge and has essentially eliminated the need for the diesel generator. The system saves 15,200 L of diesel fuel and 1,400 L of propane a year. Purcell Lodge saves approximately $10,000 a year from lower fuel consumption and $8,000 a year from helicopter expenses related to fuel transportation. The system cost $35,000 to install. The system therefore paid itself off in under three years meaning that electricity produced after the third year was essentially free. After 10 years, Purcell Lodge would have saved $100,000 (not including the savings from reduced fuel transportation fees) and reduced GHG emissions by about 430 tonnes (at 43 tons/year).[26]

6. The Potential of Pollution Offsets

So far we have seen that both government and First Nation communities face barriers in accessing capital markets. First Nations do not have the collateral to obtain loans and governments do not have a capital account. We have also seen however, that in spite of this, there are instances where implementation of RES's have been successful. The three case studies examined have one factor in common – each had access to capital markets. Both Deer Lake and Rankin Inlet were funded by provincial or territorial utilities that had access to capital markets and Purcell Lodge is a privately owned company which also had access to capital markets.

The solution, then, is to provide First Nation communities with such access. One way this could be done is through an incentive based strategy such as a Tradable

[26] Climate Change Solutions (2003)

Emission Permit system (TEP) such as the one proposed by the federal government under the Kyoto Protocol.[27] In this type of system, each permit allows a firm to emit one unit of a specified pollutant. The amount the firm can emit will therefore depend on the number of permits they own. Emissions trading enables a given emissions target, such as Canada's Kyoto target, to be met at lower cost than with conventional regulations. The cost savings are possible because sources have more flexibility in the choice of emission reduction actions. Sources with low-cost reduction opportunities can implement larger reductions and sell their surplus reductions at a profit. Sources with high-cost reduction options can save money by purchasing surplus reductions from other participants instead. The overall emissions target is maintained but the total cost is reduced.

A common provision under such systems allows firms to earn credits for financing projects that decrease GHG's at unregulated firms or sites. Each credit obtained in this fashion would be equivalent to an emissions permit. Such a provision is termed a Pollution Offset or Emissions Reduction Credit.[28] This would be allowed due to the characteristics of global pollutants which are such that it doesn't matter where abatement occurs; a reduction of one tonne of GHG's in a large city such as Toronto, would have the same effect on the environment as a reduction of one ton of GHG's in a remote First Nation community.

An offset system can increase the cost savings by allowing entities with potential GHG reductions/removals not covered by a TEP system to participate in the trading program by supplying offset credits. First Nations could therefore take advantage of this provision by offering a RES project to a private sector business as a way of earning

[27] Climate Change Plan for Canada
[28] Tietenberg, pg 374-375

pollution offsets. By funding a RES project in a remote First Nation community, businesses would in effect be purchasing the resulting offset credits produced. The business could therefore comply with the TEP system by reducing their own emissions, buying permits or investing in a RES project with a First Nation community.[29]

The financial return earned by an RES offset project will depend upon the difference between the market price for credits and the cost of creating the credits. In addition to the cost of implementing the project, businesses will generally incur the cost of complying with the requirements of the offset system, including the cost of having the project validated and the cost of periodic verification of the emission reductions/removals achieved. Such an arrangement will therefore only function successfully if the market value of credits exceeds the administrative costs of creating them.[30]

Offset system projects would also require a governing body. This authority could be a federal body, a federal/provincial/private sector body, or a private sector/provincial body with federal government oversight. The authority would be responsible for the administration and would facilitate consultations between First Nations and potential offset credit purchasers. The authority would also be responsible for providing guidance on the legal framework of such projects, resolving disputes and monitoring and reporting any subsequent GHG reductions.[31]

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[29] Government of Canada, Designing a GHG Offset System for Canada (2003)

[30] Ibid
[31] Ibid

7. Summary

This paper is by no means a comprehensive survey of the barriers that first nations face in implementing renewable energy systems or of the solutions to such barriers. There are still many questions that need to be asked and options that need to be investigated.

This paper does however highlight some of the barriers that First Nations face in implementing renewable energy systems. It is evident that the Canadian Government and First Nations have reason and incentive to work together to ensure RES are implemented. Renewable energy systems will reduce the flow of resources out of First Nation communities and will help the local government generate their own source of revenue, which can be used to provide infrastructure and social programs. Ultimately it will be a step towards self sufficiency and autonomy which can help break the cycle of poverty. From the governments perspective, implementing a RES would be a step towards implementing an efficient energy system that is cheaper, cleaner and more cost-effective than the current diesel system. As well, the associated reduction in GHGs would go towards fulfillment of Canada's Kyoto obligations.

Although there are several potential barriers to implementing renewable energy in remote First Nation communities, the most significant barrier is the inability of both government and First Nation communities to access capital markets. A promising solution would be for private industry to invest in such projects through a pollution offset system. Under a tradable permits system, such an arrangement would lower the cost of abatement, reduce GHG's and provide First Nations with the opportunity to implement renewable energy systems

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