Microhydro, Wind, Solar Case Study

Interview with Kenny Rabnett August 2006

Introduction

If you live by a stream that has a reasonable year-round flow, then you may be in a very enviable position from a renewable energy standpoint. While micro-hydro systems may take more effort to install, they can cost considerably less than photovoltaic or wind systems and can provide an uninterrupted supply of energy, rain or shine.

A micro-hydro system uses water to turn a turbine, which is much smaller than a wind turbine for the same amount of energy production. A typical system consists of a dam and water intake, a penstock (system of pipes) that brings the water to the turbine, and a tailrace that takes the water away from the turbine back to the stream. Through the use of a generator the power is converted into electricity and is then either used immediately or stored in batteries.

To produce hydropower, you need enough flow and pressure. The distance the water falls is called the *head*, and the distance the water flows is called the *run*. Having a higher head will result in more energy production than will a long run.

When a good site exists there are various hydropower systems that can be effectively utilised, depending on the system design and site configuration. In Canada we are most familiar with big dams that provide hydropower to a large number of people. However there are also smaller, lower impact versions of this technology. Pico, micro or mini hydropower projects should undergo fisheries and impact assessments to ensure that they are truly a low-impact renewable energy source. The case study that follows is a good example of a micro-hydro project.

Types of Hydro Power
Pico: 10kW or less
Micro: 100 kW or less
Mini: 100 kW to 1 MW
Small: 1 MW to 30 MW
Large Scale: 30 MW or more

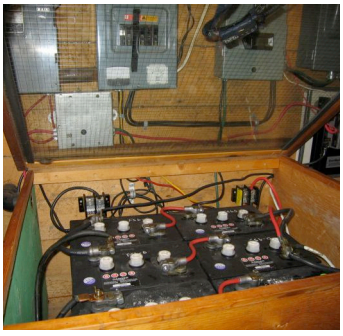
Canadian Renewable Energy Network www.canren.gc.ca.

Case Study

Two residents of a home situated in the Suskwa Valley, just east of Hazelton, live completely off the grid, relying on microhydro, wind, solar, and generators to supply power. The house is 2-stories with a footprint of 40 by 24 feet. The nearest neighbour is 12 kilometres away. Kenny and Nabby live on a large piece of land with their cat, two dogs, and chickens. They began experimenting in the early 1990s with renewable energy technologies to try to meet their needs because they were so far off the hydro grid. They started with 2 solar panels in 1989 then upgraded to a microhydro system in 1995 and two more solar panels in 1996 to meet their growing power needs. Between 1997 and 2000 they added a two-turbine wind power system. In 2006, they added 8 more solar panels and a tracker. This puzzled together system contrasts systems that are designed from the beginning to meet very specific needs. There was, for instance, a higher degree of experimental or 'trial and error' methodology. Primarily the residents themselves, in consultation with Northern Alternative Power Systems, a small company in northern Alberta, installed the systems. Kenny also contacted friends who have renewable energy systems for advice on installation and problem solving.

Their current electrical load consists of lights, 2 laptop computers, a stereo, and a few other accessories. They have a motor to run power tools, a grain grinder, and a juicer. They use a wood stove to heat the house and provide hot water, effectively eliminating any electrical demand for these needs. They use power about 50% of the day.

The power for their systems is digitally controlled and stored in batteries. They have a small inverter to change some of the energy from DC to AC. However, they do run most things, such as lights and the phone, off DC power because it is cleaner and more efficient. There are six batteries wired in series and parallel, enabling 12-volt capacity. The batteries are forklift batteries and cost around $2,000 total. They are expected to last about four years, although to date they have lasted longer than anticipated. The batteries are the part of the system that requires the most attention, according to the owners.



Microhydro System – (Cost: $1,500)

The water source is 1,000 feet (run) away from the house in a small creek. Pressure is built from the 34.5-foot drop (head). The water flows through a 1¼-inch underground waterline to a small turbine, which turns a 12-volt generator in the basement of the home. Kenny would have liked to install a bigger water line, however they lacked the funds at the time to accomplish this. The wheel turbine is a Lil Otto© which cost $650 US. The creek normally runs all year long, however due to an exceptionally dry summer, the system was non-operational for several weeks this year. This contributed significantly to their recent decision to expand their solar system as opposed to upgrading the microhydro. On the other hand, Kenny still holds that microhydro is the best renewable technology when there is a reliable water source. Microhydro is seen as superior because it is reliable, simple to maintain, and provides a constant flow of power day and night.

Solar System – (Cost: $10,000)

The original system, installed in 1989, consisted of two 50-watt panels at a cost of $380. They were able to generate enough power from these panels for several years. However once their energy demands started to grow they added two more solar panels in 1996, and then recently, another eight 110-watt panels mounted on a Wattsun tracker© (cost $3000). The tracker maximizes sun exposure as it moves with the sun throughout the day thereby maximizing power generation. The system is located about 160 feet from the battery bank, which in turn ranges from 8 to50 feet from the electrical load. Efficiencies are lost with distances.

Wind System – (Cost: $1,000)

The wind system consists of two wind turbines located on a 50-foot tower adjacent to the house. The tower base is cemented into a 2½-foot square block and can be lowered via a hinged affair. The tower is on a hill with the potential to gather increased wind, but there are a few trees nearby that affect wind patterns and reduce the effectiveness of the system. The system runs about 100 days a year and is most productive in the spring and summer. The wind turbines are Southwest Windpower Air 303's © and Kenny was able to get them free through personal connections. The two wind turbines, though the same model, have different start-up speeds due to differing blade configurations. One turbine starts to work at wind speeds of about 11km/h, while the other turbine starts to work at 13 km/h. They have had no serious problems with the wind system, though they once had to take down the turbines for maintenance. Ordinarily the wind system only requires about an hour's worth of maintenance each year.

Conclusion

Overall Kenny is satisfied with his systems and would encourage others to use renewable technologies. Given the current 'crunch' for energy, Kenny recognizes the importance of developing these technologies. He notes that having these systems makes people much more aware of their energy consumption and in turn causes them to act more responsibly. The primary problem of these technologies, from Kenny's perspective, is that they still have a fairly expensive start-up cost. He did not face any major problems in the course of experimenting with these systems, but it did take a lot of energy to see the projects through. His systems are now too big for the control system because it was pieced together over time, without the anticipation of future expansion. In Kenny's experience renewable technologies are practical solutions to power demands, especially if you live off the hydro grid.

Case study by Allison Bryan, photos by Greg Brown