Wind/Solar Hybrid Case Study

Interview with Anastasia Ledwon – August 2006

Introduction

A typical wind turbine is comprised of a rotor or propeller assembly, a body (which contains the generator or alternator and the tower attachment point) and a tail vane. The wind flows over the rotor blades, causing them to spin, and turning the generator housed in the body, which then produces electricity. The tail vane keeps the rotor turned into the wind. It can also turn the turbine out of the wind when wind speeds get too high. The turbine is mounted on top of a tower to keep it above obstructions to the wind's flow.

The height of the tower makes a more significant difference than the size of the blades in terms of energy production. Depending on the size of a system the wind-speed needed varies, with the slowest starting at about 15km/h and the ideal at least 29 km/h. Systems are also designed, depending on capacity, to shutdown when speeds get too fast, like in a major storm. These features help protect the system and maximize efficiency. Where there are high wind speeds and no obstacles that would disturb wind patterns, wind systems can generate a significant amount of power. Even in a good location however there are rarely constant winds, and therefore power often needs to be stored or supplemented with another system such as solar panels or a generator. The following case study examines a small-scale wind/solar hybrid system.

Case Study

Anastasia's home is situated on 160 acres of land between Houston and Quick, BC and has a wind/solar hybrid system installed. The land was partially logged 10 years ago and the home built in the centre of the property. The house faces within a few degrees of due south and the property slopes to the west towards a river. The three-story, 3,400 square foot home was built initially in 1985 and renovations were undertaken in 2002. The home now operates completely off-grid (previously it operated solely off of a diesel generator), with the nearest hydro lines are a kilometre away. Anastasia and Richard who live and work there rely on wind, solar, and a propane generator to meet their power needs.

Anastasia's house with solar panels on roof

After doing some initial research on various system options they had to decide whether or not they would connect to the hydro grid or stay off it. BC Hydro gave a varying quote ranging from $15,000 to $50,000 to install hydro poles and connect to the grid. It would have cost a least $5,000 to get several different permits and complete some required blasting and logging before BC Hydro would have been able to give a more accurate estimate. Given the length of time and the work involved to go this route, it was decided to assess other options. The general aesthetic value of not having hydro poles on the property, the speed of installation, the cost, and the appeal of living completely independently led to the choice of the off-grid system. Once this decision was made research had to be done to more seriously evaluate the electrical needs, and the feasibility of various wind and solar systems. Books, magazines, websites, and people in the area with renewable technologies were consulted for information. The company Energy Alternatives in Victoria was contacted and a package was put together. It was decided to have a wind, solar, and propane generator system. The system was paid for at the end of April, then the parts arrived in pieces throughout May and June. The solar system was set up in July and finally the wind system and generator were set up in August, completing the system.

Wind turbine in the background

Anastasia and the other owner at the time set up the system mostly themselves in consultation with Energy Alternatives. One of the owners had some mechanical and electrical knowledge, which helped significantly. The various manuals acted as good guides, laying out step-by-step instructions. Extra help was contracted when needed, such as a cement truck and a backhoe. The installation process demanded a significant amount of work and energy to complete on top of specific complications that arose. There was a lot of preparation work that needed to be done for the wind system, which is located 50 metres from the home. Normally anchors can be twisted into the ground, but

because there was so much clay and rock in the ground, trenches and anchor holes had to be dug then concrete poured before the tower could be raised. Putting the solar panels on the roof was particularly challenging because of the steepness of the roof and the fact that it is 20 feet off the ground.

The home has a considerable power load that can be accommodated by this system. The regular load consists of 2 deep freezers, a fridge without a freezer, compact fluorescent lights, a TV, a DVD player, a stereo, a washer, and 2 laptop computers. The water pump consumes a lot of electricity and they are trying to find a way of making it more efficient, such as using a gravity fed system. Anastasia and Richard also have a desktop computer, electric blanket, microwave, and toaster they rarely use, as they require a lot of power. They use power tools for construction, which use a lot of electricity, especially when they are first turned on. The generator kick starts automatically when the wind and solar systems cannot meet these demands, using about 1,872 litres of propane a year. Anastasia says that being off the grid makes you more conscious of energy consumption and allows you to control energy intake. This manifests itself through things such as the use of power bars, or being pickier about appliances that are bought and used. They have no meter keeping track of their aggregate energy consumption, though there is a meter that shows the actual watt demand at any particular time. They have a stove, dryer, and hot water heater that have electric starts but run off propane, consuming about 757 litres of propane a year. There are 2 Blaze King high efficiency wood stoves that provide heat for the home, consuming about 10 cords a year.

Generator shed

Conclusions

There are only a few ongoing maintenance requirements that add up to about 1 hour of time a month. For example, the batteries need to be equalized every six months. The generator requires changes in oil, oil filters, air filters, spark plugs, as well as getting the propane tanks filled. The bolts and guy-wires need to be tightened on the wind system once a year. The homeowners have not experienced any problems that required outside assistance other than on one occasion, during a major storm, when the wind turbine tail got stuck in the wrong position. There was a concern that the tower might have to come down to fix it, but after the next storm the problem corrected itself. Apart from those issues, the only other main consideration is re-setting the system when it is overloaded.

The peak season for the solar panels is the summer, while the wind system is most productive in the spring and fall. They are very satisfied with their system though they are planning on making some additions. They are going to put on more solar panels to meet their needs, would like an on-demand hot-water heater, and are considering solar walls for heating. Anastasia would recommend these technologies to others, making an active effort to dispel misconceptions.

Basic Cost Breakdown

Key System Components	Description	Cost
4 Solar Panels	120 watts	$4,800
Wind Turbine	1 kilowatt, Brgey©	$2,600
Wind Tower	100 foot, Brgey©	$1,000
Propane Generator	12 kilowatt Onan© (no longer available)	$6,500
Power Panel	110 volts Xantrex© Inverter, Control Panel (Trace Engineering©)	$8,000
12 Batteries	2 volts (parallel into 24 volts), Deep Cycle Golf Cart Batteries	$2,400
Miscellaneous	i.e. wiring, backhoe, concrete, shipping, scaffolding, rebuilding generator shed, propane lines…	$3,500
GST		$1,200
TOTAL		$30,000
2 Wood Stoves	Blaze Kings; 10 cords a year	
Propane	$1,200-$1,500 a year	
**There is a PST exemption when systems are bought in their entirety*		