Issue 4:6 - Jul06 - PCubed - WattPlot - Cogging - Muni Planner - WindsAtlas - PV Trackers

info@truenorthpower.com

Issue 4:6 Headlines:

P-Cubed Showtime

WattPlot - Wind and Solar Performance Monitoring Software

Alternator Cogging and Performance

Municipal Planner Guidelines for Small Wind from CanWEA

Using a Wind Atlas and Google EARTH for Site Assessment

Solar Trackers - What to Look For

P-Cubed Revealed

Some of you saw the concept article we published last year . . . now the Personal Power Pack is a reality and just today got a very cool paint job . . actually a "vehicle wrap" to show off when it's on the road. The P-Cubed consists of a trailer mounted solar/wind power plant with a 3.5 kW Outback E-Panel, MX60 controller and 1000AH sealed Champion battery pack. Here's a picture of it during initial deployment testing before getting outfitted at the FREE Wind Test Centre last week. Now it looks like this.

The P-cubed has a self-contained 800 watts of solar and 900watts of wind that can be deployed almost anywhere. You can have power the moment you pull the parking brake and start generating your own free local power in literally a couple of minutes.

It was originally designed as a portable training vehicle for the weekend workshops we've been hosting at the FREE Wind Test Centre for the past 3 years, but as soon as we began showing it around we got several requests for quotes from various companies and even individuals who want their own portable power they can take anywhere. take it to the cottage in the summer . . plug it into your home in the winter..

WattPlot - Wind and Solar Performance Monitoring Software

There's not a lot of easy ways to monitor and control the performance of your hybrid system without having several controllers and various connections for each. Most battery suppliers don't make the "gas gauge" for their batteries and few solar panel companies sell a watt meter with their panels. Fortunately, major inverter and solar controller companies offer a meter or even data logging for their equipment . . but none offer a truly integrated package of software that will monitor the overall health and performance of a whole wind and solar system. Enter Intellact (a great Canadian software company right here in Ontario. . They have jsut recently launched "WATTPLOT" software for Outback systems. Outback already has a private network with their HUB4 or HUB10 Ethernet like interface that allows their MATE, MX-60 and FX inverters to communicate over a common network to take control and share information. Andrew Welch from Intellact has developed WATTPLOT to "listen in" on those conversations and log or plot performance information and even send controlling signals to the MATE or MX-60 to change control parameters from your home computer and very soon, I expect, even over the Internet.

I don't have a lot of experience with this interface yet . . just finally got it installed on my computer last week . . . Unfortunately it's hard to find a simple (DB9) cable to plug my computer into the MATE. These cables are easily available at any electronics shop, but out here in the boonies . . north of Wiarton and Owen Sound they are harder to find than I thought. At any rate . . it's been pretty thoroughly wrung out by a number of BetaTesters in Canada and US so I'm pretty confident you'll find it a winner . . . I've seen a couple of other companies attempt to do this from but I really like the simplicity of the interface as Andrew showed me how it tracks and logs every second of performance of his LAKOTA-based hybrid system . . . Andrew's done a very nice job of making a good intuitive interface. He's made the necessarily complex control structures of the Outback easy to manipulate. WattPlot displays the simple performance data of any parameters you want to know about. . . how much power is the system making right now, last night? . . or last month? . . and what configuration is best for my system to get the best performance? . . It even has a nice "simulator" mode where you can try things and see what might happen if you choose this mode instead of that one. Outback has made a beautifully versatile power management and control system with

lots of very useful features. All it needs is a little WATTPLOT to make is more user friendly for the average-techie who wants to see the power of the whole system, second by second or over the last month.

You'll find WATTPLOT a FREE Trial easy download from the Intellact site. If you like it then you can buy it for $159. As a LIMITED TIME OFFER until 30 July . . Tell Andrew you heard it from TRUE-NORTH Power Systems and if you do buy it, send me a copy of the invoice and I'll send you a $15 cash rebate from TRUE-NORTH. . . I don't have any ownership in Intellact . . I just like their software . . . but believe it or not I can actually make a little money by paying you $15!

Alternator Cogging and Performance

Small wind turbines (at least the ones for home use) generally operate as a brushless alternator. That is a set of coils of wire that are either fixed or rotate near some very strong permanent magnets. The rotating windings are not as reliable normally for high speed alternators . . better to have the magnets rotate either inside or outside the windings and very close to the wires coils (windings). Each time the magnetic lines of force pass through a length of wire a few electrons are shunted one way and then the other along the wire, producing what's called "Wild AC" alternating current. It's "wild" because it depends on how fast the magnets are moving . . . and they move faster the faster the wind speed. So as the wind gusts and dies the voltage and current is constantly changing. The wild AC is then fed through a RECTIFIER that changes each AC cycle to a pulsed DC power that is absorbed by the batteries or fed to an inverter that can manage this kind of DC power.

Since the magnets are passing very close to these coils of wire wrapped on an iron core there is a strong magnetic pull as it passes the closest point to each wire. On some alternators you can feel these magnetic "bumps" as you rotate the drive shaft, especially if they are very powerful magnets . . and this is "cogging". With strong cogging it take more wind to overcome that first magnetic "bump" to get the blades started, but the more power you can produce each revolution, once it's running. The closer the magnets pass near the coils of wire and the stronger the magnets the stronger the cogging . . but the stronger

power produced as well. Magnetic force fields are exponentially stronger as you get closer and closer to touching the surface, you get the more electrons are shunted in the wire coils with each pass. . (just try and hold off any magnet from touching but try and get really close without touching) . . . so the trick is to place the magnets very close and precisely (less than a millimeter if you can) but not too close so they touch or so the cogging is too strong . . If they are too far away where there is no perceptible cogging the maximum power will be less. If the cogging is very low or smooth then, . . . here the energy field is weak and will not generate as much power. It is possible to achieve the same power with very low cogging by using bigger magnets and bigger coils, but eventually the size of the resulting alternator itself becomes too big and heavy to be practical.

Other strategies to limit or reduce cogging, without making the gap wider or the magnet weaker, is to increase the number of magnets so each "cog" is short duration and easier to get over the start-up hold back that exists with small gaps and strong magnets. But many smaller magnet produce more shorter duration pulses because the magnetic field of each magnet reaches max intensity for a shorter time . . . producing less current. It's an engineering tradeoff that each alternator manufacturer must wrestle with. How strong can I make the magnetic field without stalling the rotational motion when it's at rest, yet still produce the most possible power when it's flying?

For fixed magnet alternators with the desire for low startup wind speed but lots of power . . it's a delicate trade-off.

Municipal Planner Guidelines for Small Wind from CanWEA

The CanWEA small wind turbine site now has some recommended guidelines for personal and small wind systems. These guidelines are for individuals as well as municipal planners and councils to consider. There is no hard and fast rules for installing small wind and any municipality who tries to make a universal "one size fits all" approach will find that nothing works for everyone. The "uses" of the system have more relevance to by-laws than the actual size, so setting limits just based on size does not work very well in most cases. In general however, turbine systems under 10kW is more than enough power for most for homes and small businesses. For example, you could almost run an "all electric" home net-metered with a 10kW machine, however, the size and the noise and the cost might be unacceptable to most home owners. Ont the other hand, the cost and size and quietness of a 1-2 kW machine

might be fine for small home but it won't produce enough power most of the time, and being net-metered with such a small system may only make sense for a weekend cabin.

So how do you decide which guidelines apply to a single user still connected to the grid with a small property and which ones are best for other uses, like powering a dairy farm or a commercial greenhouse? It's not straight forward but it's not rocket science either . . it just takes a little common sense . . and these guidelines will go a long way to getting some sensible by-laws written. Some advice for municipal planners . . "Don't
try and find an existing bylaw to apply to wnd turbines. they are unique structures and do not have typical "foundations" or setback needs as buildings or other structures. Give it some thought as an original device not like other devices" . . . I hope the municipalities are open to discussion and willing to encourage renewable energy owners or we'll have more misleading information like "wind turbines kill birds".

Just a moment on the topic of "turbines kill birds": for example there was quite a lengthy article in the Owen Sound Times this weekend describing all the negative and some positive aspects around the new wind farms being developed in Ontario. Remember "Small Wind is NOT Big Wind" but everyone seems to just assume they are the same. They talked about farmers being for and against and how many are upset with how these windfarms are being sited . . especially in Grey Highlands south of Collingwood where there is a pretty vocal "STOP the Wind" campaign being waged. They noted that wind turbines are expected to kill 2 birds per year per turbine . . . how they got that is unclear but it continues to hype the idea that wherever wind turbines are installed you can expect more birds to be killed every year. Well here's some "RAW statistics" of my own. This is REAL data not a statistical calculation but don't read on if you're squeamish about carnage.

In the past 4 and a half years since I've installed, participated or observed over 100 small wind turbines and a number of other commercial machines. I've yet to see ONE dead bird . . or even HEARD for an actual case of bird kill caused by a wind turbine. . . Not to say it does not happen or has actual cases in California wind farms of the 80's and 90's but none I've ever witnessed as a systems designer / installer. On the other hand, I drove from Lions Head to Exeter Ontario (about 3 hrs each way) on different county roads on Sunday June 25th, and counted 53 blood spatters on the road as I drove. These were fairly fresh kills, since I noted but did not count many more that looked older than a week. That's a lot of carnage on a half dozen roads in Ontario covering a weeks or so time period. That's been going on for years with little concern from people who are upset about birds that "might be killed" by wind turbines. . . . and that's not the half of it . . in addition to the 53 splatters I unfortunately counted other actual bodies of dead animals that had not yet removed from the roadways . . . 8 porcupine, 9 groundhogs, 3 skunk, 5 rabbits, 17 raccoons, 2 fox and 2 deer . . not to mention 11 birds.

That's on a 500km stretch of road IN ONE 6hr ROAD TRIP. Do not tell me to worry about potential wind turbine bird kills until you show me you are concerned about that!

Using a Wind Atlas and Google EARTH for Site Assessment

We'll do a much more in-depth look at using the Ontario and Canadian Wind Atlas' for assessing wind sites some day, but for now I thought I take a quick look at how to make use of them for personal systems. First and foremost, these tools are designed for commercial wind farm early analysis . . .they are not the answer for small wind siting but they do give you some important information if you use them wisely. Like any available "Wind Atlas" they cannot tell how the wind behaves on YOUR property below about 100 feet above ground, because they only extrapolate some numerically significant data about wind in your area. Ontario Wind Atlas will even suggest the data has a resolution of one kilometer square and down to 10 meters (about 30feet above ground). . . . but if I put my GPS coordinates into the system my property is shown to be located about 1-2km off shore in Georgian Bay. Not bad for 1km resolution but not a very accurate map for the wind cell on my property . . and based on the colour 1/2 m/s slower than the wind on the land. Likewise the Canadian Wind Atlas suffers from resolution that can actually match a LAT/LONG with my property so as long as I understand that there is much to be gained by knowing the general upper winds in my area . .ie "north of town a few km or east of the shoreline as opposed to north of the valley etc."

The best I can do is understand the general relationship between the wind 100ft over head and the local obstructions within a few hundred yards of my property. . . . and the best way to do that is some aerial photography. . . but guess what . . there's now something better "Satellite Photography" with the help of Google Earth.
Go download a copy of google earth and you'll be able to "fly" down to a few hundred feet over your property in MANY but not all areas for the world, with enough resolution to actually see cars in the driveway and shadows on the lawn. I can almost count the number of solar panels on my roof since they updated the Canadian part of the database with imagery for the Bruce Peninsula. This is a great resource for looking at your local tree lines and wind corridors, especially when used in combination with a local Wind Atlas. You can tilt, pan and zoom for a better look at all the angles. Then decide how the trees and other obstructions will effect the "dominant wind power and direction" data that you are seeing from the wind atlas.

I've played around a bit with google earth and the wind atlas and if you're clever with screen shots in photoshop you can even superimpose the windrose over the satellite view and find the best place to avoid or minimize that upwind turbulence. . . have fun!

Solar Trackers - What to Look For

A solar tracker is just a device that keeps you panels pointing at the sun when ever it's above the horizon. They are usually mechanical systems with at least an azimuth drive and often both azimuth and elevation so that they are effective in all seasons when the noon sun is high in the summer and low in the winter. Typically, solar trackers add up to 50% more watts to the total monthly production and so may be worth the cost and effort, especially if you have only a small area for mounting panels. You'll get the most output for the smallest area.

If you are going to use a tracker I'd also suggest you invest in a good MPPT solar controller like the Outback MX60. Maximum Power Point Tracking circuitry is not part of the simpler less expensive controllers like the Xantrex C30 C40 series or the Morning Star, Sun Saver Prostar or Tristar controllers. These are all good PV controllers but their relatively simple circuitry makes them inexpensive but less efficient at getting the available electrons INTO the batteries. To get THE MOST out of your expensive PV panels you need to track the sun. As I showed in a previous newsletter it doesn't have to be complicated and expensive. You can just adjust the tilt for the season or even daily or even point them by hand any time, if you are so inclined.

Advantages:

Fits in a smaller footprint usually in almost any corner of a yard

Much better power production. 30-50% more Amp Hours overall

No roof mounts, no roof leaks, no excess wind load on the roof

No Code issues with building inspectors, or possible insurance issues due to roof penetration

No climbing roofs and less reaching to clean or remove snow

Disadvantages:

Additional Cost . . but don't forget to subtract the cost of roof mounts for an accurate number

Mechanical maintenance potential. These are mechanical systems.

Takes up some yard space, mowing around, kids playing, damage potential just be being more accessible

The suns radiation and the effects of what we actually feel and can convert here on earth are a complex combination to physics and atmospherics modeling. It's effected by the wavelengths you are talking about, how dry or much moisture there is in the air, dust particles and lots of other stuff if you are interested try here or here. . . but what really matters here on earth is, the time of day and the season of the year. When the sun is near the horizon solar rays may travel through as much as 1600kms of atmosphere before it hits the solar array. But pointing the array directly at the sun at dawn, the

performance is limited because the light is being scattered and absorbed by water moisture and small particles in the air. The period around sunrise and sunset have limited potential production but once the sun reaches about 15 degrees above the horizon a direct facing panel can make some significant power. At noon, light travels through less than 100km of atmosphere. . . . and you have to be "off angle" by more than 10-15 degrees to loose more than 1% of the capturable energy . . . so you really only need to "roughly" track the middle 120 degrees of the sun's daily path. that can be done with a single axis tracker in lower latitude where the sun passes fairly high all year round.

Trackers can be single or dual axis. Dual axis will do better during the end of June "Summer Solstice" but not much better than during the spring and fall "Equinox". Click here for better understanding why. Around "Winter Solstice" 21 December, the power consumed by the 2 motors needed to drive the array become more significant. The extra cost and complexity of a dual drive then may not be worthwhile in all cases. If you want to know the EXACT time of all these special solar angles CLICK HERE.

There are lots of different ways to build a tracker and a number of companies who build them, but if you live north of the 40th parallel . . . with cold and windy winter climates . . . there is nothing more rugged or reliable than the "Sun-Link" tracker from Laurence McKay, owner of Northern Lights in Sault St Marie, Ontario. Laurence McKay has been designing and building these systems since 1995 and over the years since the first ones were made, they've built quite a reputation for reliability. I spoke to Laurence the other day and also spoke to a number of his clients. You can visit their website for more info at http://www.sunlinksolartracker.com/

info@truenorthpower.com