

## Elements

By Kevin Pegg

# Energy System Monitoring

The right tools to know what is going on with your system.

I get a lot of calls from clients with battery-reliant off-grid electrical systems who are frustrated that their batteries haven't lasted as long as they were promised. It is difficult to predict the lifespan of batteries as they degrade in proportion to how hard they work. Often, when I ask these people how they determine when their batteries are too low, and it's time to fire up the generator, they tell me, well, that's easy; once the system completely shuts down.

This is akin to not having a fuel gauge and waiting for your car to run out of gas before you look for a gas station. Sure, it's an absolute measure of how much fuel is in that tank, but can also be rather inconvenient and expensive.

There are better methods to know what is going on with your system! The fine details of which metering system is suitable for your situation is best discussed with your renewable energy professional.

Prior to that, you should answer the following questions: What information do you really want/need? Do you want a very basic snapshot of the

system status? Do you want to know how much energy is being produced by your solar, wind or microhydro systems? Do you want to have a record of this, so you can analyze your system performance in retrospect? Do you want to be able to access this data over the Internet? These are all possible.

Don't forget about location. (Consider this for



The Mate monitor displays all the components of your system, though the author feels it is too technical to be as efficient as other systems available.

new construction). For a monitoring system to be most effective, it needs to be located where it is readily available. Your fuel gauge is not in the trunk of your car, so why should your electrical system meters only be in the mechanical room?

The best metering systems are integrated with the inverter and other system components, such as charge controllers and automatic generator start systems. These are typically found on higher quality inverters, (2 kW and larger). Modern inverter systems have come a long way in this respect; older inverters might have had green, amber and red indicators if you were lucky. Sticking to the same brand for your inverter, charge controller and accessories will allow you to have an integrated monitoring system that provides at-a-glance information of all the components and how they work together.

The Xantrex XW system, one of the newest (and in my opinion, certainly the best larger inverter system) on the market today, has a very well thought through monitor, called the System Control Panel (SCP). It operates on a network protocol called Xanbus, which is a modified

### NOT EVERY SYSTEM WILL REQUIRE THIS EXTENT OF INFORMATION. HERE'S A RUNDOWN OF OTHER OPTIONS:

**Voltmeter** This is the most basic metering option to give you the most basic amount of information about your system. Battery voltage is similar to the fuel gauge in your vehicle. As you use energy from a battery, the voltage will drop until such a point when it needs to be re-charged. Digital voltmeters are best, due to their accuracy.

Voltage is only part of the equation, as it needs to be considered with whatever else is going on with your system. You need to look at factors such as the sun; if it's shining and charging batteries, the voltage will be higher. Conversely, if you are drawing power from the system, the voltage will be lower. Though you need to consider other factors, voltage can be a fairly simple method of measuring power and certainly lets you spot trends in system performance.

**Ammeter** This measures the current (amps) flowing. It can measure the positive amps, showing how much energy is being produced, or the negative amps, indicating how much energy is being removed from the system.

As ammeters require the current to flow through, a device called a shunt is commonly used, which allows you to precisely measure the current and transmit that information via thin wire.

Ammeters can be installed in many different locations depending on the information you desire. If you are looking for net amps in the system, the ammeter must be installed in the main negative lead. If you want to track how much energy is flowing from your solar, wind or microhydro plant, the meter must be installed on that feed.

It's best to have ammeters on all charging sources, so you are able to spot trends in the system performance and react if it changes.

**State of Charge Meter** These meters, such as the TriMetric or PentaMetric systems, use a complex formula known as Peukert's Equation to give you a percentage of battery capacity remaining. This attempts to determine the actual power left in your battery bank by factoring in the rate of which the energy is removed. Batteries are not linear—the faster you remove energy from a battery, the less energy you have. Using 100 amps of energy for one hour is not the same as one amp for 100 hours.

In practice, these meters require constant re-calibration in order to be accurate, as batteries age over time, requiring re-calculation of variables in Peukert's Equation. I find in general these meters confuse people more than they help, and require constant vigilance to maintain accuracy.

version of Canbus, the same protocol used in modern vehicles. It is connected to the inverter, charge controller, generator start modules, etc. using a Category 5 network cable (common computer network cable). You can have multiple SCPs in a system, and they can be up to 300 metres away from the inverter. The SCP uses plain language and is easy to navigate for even non-technical people. It can give you a general at-a-glance overview of the system, or you can drill down to the very specifics of what each individual device on the network is doing. There are add-on devices that allow this information to be streamed over the Internet, as well as logging of system performance for future analysis.

**OutBack** inverters also have a similar remote monitor called the **Mate**, which allows you to see what is going on with the entire system, as well as details of the individual components. However, unless you are very technical, the Mate can be very confusing. Most of the same information offered by the XW system is there, it's just presented in a confusing, often buried manner. I've been working with the Mate for several years, and still need a manual with me; whereas, with the XW system, I glanced at the manual once and now have all the information needed for even the most complex installations.

What works best for your system will depend on the complexity of your system, how you use it and what information you desire. It's important that any system—even the smallest one—has some means to view system status. 🌐

**Future Technologies** There are many new technologies being developed all the time for the monitoring of electrical systems. People who are on-grid are starting to see smart meters, which offer you real-time feedback on how much power is being used.

Many of these new technologies are Internet-enabled, and have programmable functions such as alerts to notify you remotely if something is awry with system performance.

Energy Alternatives has been developing a new metering system and expect it to be ready for full public release before the year is up. Stay tuned for details on that.

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