Editor's Note

BY DAVID WEBB

Theory & Practice

"In theory, there is no difference between theory and practice. In practice, there is." —*Yogi Berra*

SOMETIMES, I HAVE IDEAS THAT SEEM so great (to me), I am literally astounded at my own ingenuity. The height of ego? Probably — but I think we all have those ideas, every once in a while, that fire up the motivation and cause us to wonder if any human before us has ever been so clever.

My latest? Micro-hydro electricity from a homemade turbine and an automotive alternator (see "Editor's Note," *Cottage & Cabin Planning Guide*). It had the makings of genius. The cost would be less than $1,000. The output would power compact fluorescents and small appliances in a weekend getaway. I was even going to keep readers updated on just how perfect my contraption was.

My first ego blow came when I realized I was far from the first person to toy with this idea. Whether you chat with cottage owners or just look online, you can find many examples of people who have made, or tried to make, electricity from a water wheel- or water-turbine-powered automotive alternator. But of course, mine, with my special 50/50 system (50 feet of drop, 50 gallons per minute), was more effective and built to last. Just a few things to confirm.... I needed an expert to help tie up the loose ends. Enter Kevin Pegg, of Energy Alternatives — a Victoria, BC-based firm devoted to alternative energy systems both large and small. As I related to Pegg my plans over the phone, I heard an audible chuckle. Pegg it would turn out, has consulted many people who presented him with cockamamie ideas of generating cheap, off-grid electricity — and heard the alternator blueprint more than a few times. Then the sentence came that changed my whole outlook. He asked me: "Do you want power, or do you want a project?"

Pegg explained that if I actually wanted to power a cabin, he can recommend many pre-fab micro-hydro generators. If I just wanted something to do — then sure, proceed with the alternator-based system. It will give me plenty to do — a non-stop hobby if you will, tightening belts, replacing brushes, removing corrosion and generally trying to figure out why I was not getting all the juice I had envisioned. But whether or not it will provide power, well, that was up in question. On paper, it worked perfectly, producing three kilowatts every 24 hours. Which brings me to the point of the opening quote.

The end result of my brief and soul-crushing foray into the world of do-it-yourself alternative energy? A new contributor to *Cottage*, Kevin Pegg, and the beginnings of a soon-to-be series of regular departments on off-grid energy, for the benefit of all cottagers. There may be a real difference between theory and practice, but our aim is to bring the two as close together as possible — to put a little practice in that theory, and some theory in your practice. In fact, it could be said that is what we do here at *Cottage* magazine — bring ideas to life and put life in ideas.

And if anyone else has some stories — good or bad — about do-it-yourself alternative energy, I'd love to hear them. *editor@cottagemagazine.com*

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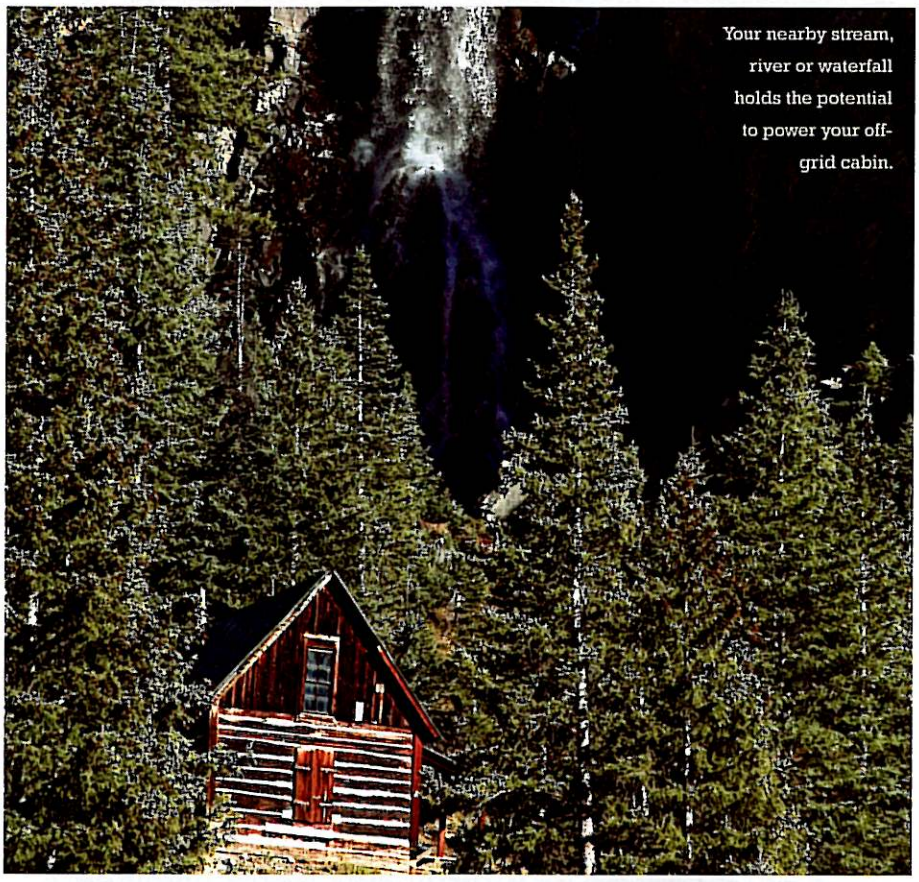

Your nearby stream, river or waterfall holds the potential to power your off-grid cabin.

Micro Hydro How-To

Tips and tricks for getting the most out of your micro-hydro system

BY KEVIN PEGG

WHEN IT COMES TO SUPPLYING ELECTRICAL POWER TO YOUR OFF-GRID cottage, there are a myriad of options and decisions to consider. The good news is today it's easier than ever to get a system to match you site, your needs and your budget. Modern alternative energy products are vastly superior in efficiency, reliability and ease of use.

One of the most efficient is the battery-based micro-hydro system. These systems harness the energy from falling water and convert it to electricity, which is stored in a battery bank. That stored energy is used to power whatever loads you have, typically through an inverter to convert to household AC power. A small trickle dropping down a small hill may give you as little as 50 watts. A raging torrent of a stream can power a large 50-plus kilowatt (kW) AC system for a fully electrically heated off-grid home. It all comes down to how much water potential your site has, and your budget.

Pros & Cons

The largest con with micro-hydro is: you either have micro-hydro potential, or you don't. Water must be falling naturally! People sometimes have a great idea to pump water up hill, and then recover the energy via micro-hydro. You will use much more energy to push the water up hill than you will recover; this is basic physics. As well, if you don't need a lot of power, you may find a simple solar panel will produce all the power you need at a much lower cost and maintenance standpoint. (The simplicity of solar should always be considered.)

The pros are vast. Dollar for dollar, micro-hydro is more cost-effective than any other renewable energy. Compared to solar and wind, micro-hydro is very consistent. It typically operates 24 hours a day, seven days a week. Some sites, it may run year-round, other sites may be seasonal. This is all OK. Winter-only micro-hydro systems, often used in coastal areas of BC, are very common. For coastal cabins, solar and micro-hydro is an ideal marriage — solar performs best in the summer, micro-hydro in the winter. (Winter ice-over may be a concern in other regions.) Due to the consistency of power, the battery bank does not need to be nearly as large as solar or wind — as you do not have to store up power for long periods of no charging.

Equipment & Flow

The selection of appropriate equipment is critical. The first step of the process is to survey your stream. You need to determine the available head (vertical drop); amount of water available; length of the penstock (pipeline); length of wire; locations of intake and turbine.

A handheld altimeter is the best tool for when it's time to determine the location of your intake and turbine. GPS units may provide altitude information, but you need a clear view of the sky in order for this to be accurate, and is often not possible. With either method, survey a few times and average your findings. (One can also hire the services of a professional surveyor.) Creative folks can use measuring sticks, a level and a helper — though this process is very tedious and often difficult to be accurate depending on the terrain.

There are many methods to determine the volume of water available. During your survey, look for natural waterfalls which will allow you to collect this water. If you can, channel this into a five-gallon pail and count how many seconds to fill. This is the simplest method to determine gallons per minute (gpm). For example, if it takes 10 seconds to fill a five-gallon pail, you have 30 gpm. The smaller the flow rate, the more accurate you will need to be. If you are fearful to step into the stream for fear of being washed away, or if the pail pulls you downriver behind it, you have a lot of water! If you have time to get caught up on back issues of *Cottage* while the bucket is filling, you probably don't have a sufficient supply.

The Turbine

Once you have the site details, you are ready to select your equipment. (It's recommended you consult a micro-hydro professional to assist with this.) I often ask people, when they approach me with a micro-hydro concept: "Are you looking for power, or are you looking for a project?" It's quite important to differentiate here. If you are looking for something to fiddle away hours, days and years on, then making your own micro-hydro turbine will provide you with endless amounts of entertainment. Automotive alternators are sometimes used — with generally poor results. These alternators are designed for a completely different application, and will require considerable electricity to excite the alternator. As they are not designed for continual operation, better buy three of them — one to be in use, and two to be in various stages of repair. Expect a couple months of operation between rebuilds. If you really want to make-work for yourself, use a drive-belt and pulley system!

For the rest of us that are looking for cost-effective, reliable and minimal-fuss power, consider a production unit. A Canadian-made product called the Stream Engine is a wonderful piece of technology. Employing the latest in permanent magnet alternators, you can expect two to three times the amount of power of a car alternator, as well as typically six to eight years between scheduled maintenance, as there are no brushes to wear out, and its bearings are designed for this type of use.

Electrical Considerations

As transmission distance is sometimes considerable, you want to pay close attention to the system voltage. The higher the voltage, the better. It's less expensive to stick to one voltage — if you think you will have a long distance, consider a 48-volt system when you buy inverters, batteries and other components. A 12-volt DC is suitable for very short runs, (30 metres maximum). A 24-volt DC system is good for runs up to 150 metres and 48-volt DC system will work in runs up to 300 metres. Beyond that, a higher voltage unit, 200 volts or above, is recommended.

The most cost-effective option is generally the one with less copper content. It's either a transformer for a higher voltage option, or larger wire size. It all comes down to what is the most cost-effective way to move that electricity. Distances up to several kilometres will often still make economic sense. It is strongly suggested a renewable energy professional be consulted for design guidance for long-distance transmissions. But don't rule it out just because you think it's too far away.

Control & Regulation

Unlike solar, which can simply be disconnected by the controller when the batteries are full, micro-hydro requires a constant load on the turbine to prevent over-speed and potentially damaging your turbine. A diversion controller accomplishes this. This unit monitors the battery voltage, and diverts excessive electricity to an external load, which can accept variable current — such as a heater element and some water pumps. There's many creative ways off-grid folks can make use of excessive power. Heating a hot tub is highly recommended — and offers a nice way to relax after a long day working around the cabin!

Power Calculators

Energy Alternatives has developed several online tools to assist in the design, installation and operation of micro-hydro systems. Their micro-hydro power calculator is available as a free download from *www.energyalternatives.ca/microhydro.* Here is a handy math formula to help you site your system:

$$\frac{\text{Net Head (feet)} \times \text{Flow (gpm)}}{14} = \text{Power [watts]}$$

ROBERT FULLERTON/DREAMSTIME.COM