

## Basics of Off-The-Grid Solar ~ Part 1

It's hardly surprising the Cariboo and Chilcotin are home to many who pride themselves on self-reliance with our rich history of cowboy pioneers and gold rush adventurers. Innovation and a desire for independence lives strong in our hearts and that includes modern day adventures like powering our homes with alternative energy sources. In this series of articles I'd like to offer some expertise in the area of home power systems, after all that's been my business for nearly two decades and if there's one thing that stands out in the pioneer culture it's how the early settlers valued community and the sharing of resources to help one another survive and get ahead.

Twenty first century technology provides us with many ways to generate our own power including solar photovoltaic known as PV panels that convert energy from the sun into electricity; wind turbines that harvest the energy from the wind; micro-hydro systems that capture the kinetic energy of a river or stream and solar thermal panels that scavenge heat from the radiant ultraviolet rays of the great orb in the sky.

One of the principal reasons why people consider generating their own power from renewable sources is the desire to make a difference; to have a smaller impact on the planet; to 'give something back'. Another equally important consideration is "can I make my own power and stop paying that greedy power company all my hard earned cash?" The answer is a resounding yes, a qualified no and a decisive maybe. Yes you can make your own power and stop paying the power company some of your hard earned cash but most of us will still rely on the power company to some extent to cover our heavy duty loads like heating or cooking.

Mostly this series of articles is for you who have made the decision to move forward with the purchase of a renewable energy source; want to do some or all of the installation yourself and want to navigate the shoals of costly and dangerous mistakes. For that reason I will be addressing the off-the-grid applications like a summer cottage, RV or remote home. The other type of power generation for full time homes on the BC Hydro grid involves what are called "grid-tied" systems that as the term suggests are putting power that you make back into the grid and reducing your bill accordingly. Grid tied systems need to be professionally installed under an agreement with BC Hydro and with an electrical permit.

Okay, lets get started. The very first question you need to ask yourself is how much power do I need. That's a question with a sharper point on it than 'how much power do I want'. It speaks to the tolerance that you have for pain in the pocketbook versus learning a conservation minded lifestyle. A poorly understood factoid is that every dollar you spend in energy efficient appliances will save you ten in system costs. Every appliance has a second price tag which is the price you pay for energy cost over the lifespan of the device. The Natural Resources Canada website has some excellent information on energy efficient appliances<sup>1</sup>. You can find info on many major appliances like washing machines, refrigerators, stoves etc. Here you will find

comparison charts of various models including their Energuide rating (how much power they use) and if they are Energy Star models (the most efficient in their category). You will also see columns showing the annual electricity cost and the second price tag.

Whether you were a prospector packing your mule with supplies to head into the 1870's goldfields or a log trucker rolling the back country roads of the Cariboo Chilcotin you needed to understand your load carrying capacity before you set out. Otherwise you'd kill your mule or break your truck. To turn that statement around, if you are a householder wanting to power your home with renewable energy you need to be intimately acquainted with your load requirements and that means doing a load analysis. A load analysis simply involves making a list of everything in your home that requires electricity. That list will include the rating of the appliance in watts or amps, which can be found on the appliance label. Also required: how many hours or minutes a day you will use that appliance.

While hardly anyone considers himself or herself to be just average so often I am asked "what does it cost for a system for an average house?" While Stats Canada or the mass media may try to tell you otherwise there is no such thing as an average house. We need to know how many persons live in the house, what are their habits, do they take long showers, play hours of video games, read books, have up to date efficient appliances or ten year old energy hogs?

Load-analysis is the foundation stone of understanding exactly where you can improve your energy conservation and reduce the bottom line cost of your system. If you are designing an "off-grid" system to provide your power with only the occasional requirement of a generator to charge your batteries the absolute key to that vault of knowledge is the load-analysis. On the other hand if you are already connected to the BC Hydro grid and want to use solar or wind to reduce your monthly bill and your carbon footprint that's called a "grid-tied" or "net-metering" system and in this case your bi-monthly electricity bill provides analysis information. Look on the left hand side of your bill and you should see a graph showing your average kWh or kilowatt-hours per day usage.

For off-grid battery-based systems used in remote homes, cabins, RV's, or emergency back-up power you can use a document available freely on the internet or on my website<sup>ii</sup>. Make your list of loads and then submit it to us for computer analysis or you can work your way through the math yourself. The bottom line will be the number of watt-hours you intend to use each day. Knowing this will tell you what size your battery needs to be to power those loads. You will then decide how many days you will need power if there is no sun or wind to re-charge your battery, this is called "days of autonomy". The end result of this exercise tells you the storage capacity of the battery in watt-hours that you will need. Informed with that information you can properly estimate how much solar, wind or other power source it will take to fill that battery.

The next step is deciding what type of battery to buy. There are many different types of batteries but we are only concerned with two types; the conventional lead-acid storage battery (LA); or the gelled battery (AGM). Lead acid batteries need to be contained in a battery box that is vented to the outside as they give off highly explosive hydrogen gas when charged and sulphuric fumes that are corrosive to metal, not to mention the adverse health effects of exposure to either of these.

LA batteries remain the best bang for your buck and it is not too difficult to build a proper container to keep the fumes contained and vented to the outside. You can use a passive vent for a small battery bank usually consisting of a two-inch poly pipe located above the battery bank. The box should have an angled top to direct the lightweight gas to the back of the box and toward the vent. Build the box out of ½" or ¾" plywood, paint it and seal the seams with caulking. The bottom can be lined with a battery tray to contain any spilled electrolyte. The top can be hinged to allow easy access to the batteries for regular maintenance including adding water and cleaning the connectors. The top edges of the box can be lined with foam weather seal to prevent gas from exiting at that point and a small intake vent should be at the bottom of the box to allow fresh air intake. If you have a larger battery bank consider a vent fan, which will run automatically when the batteries are charging. Batteries off-gas when charging so a vent fan that works directly from an auxiliary relay is a good idea and will use very little power.

Sealed AGM batteries can cost twice as much as LA batteries and have the same life expectancy but they are ideal in some situations. For example if you have a small area that cannot be properly vented there is no concern about gas or acid fumes with AGM's. These batteries can also be useful if they are used in areas where maintenance is a problem or where batteries must be mounted on their sides or upside down.

In the next article, to paraphrase Uncle Wiggily, if the saltshaker doesn't run off to Barkerville with the sugar bowl, we'll discuss what to use to charge your batteries including solar, wind and micro-hydro options and some hints on installing these components.

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<sup>i</sup> <http://oee.nrcan.gc.ca/>

<sup>ii</sup> <http://solareagle.com/loadcalc.pdf>