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Portable Solar Generators & Hybrid Emergency Backup Systems

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What do you do when the power goes out?

In the past two decades, non-disaster related electricity blackouts have increased by 124% in the US. These numbers are further compounded by the increasing incidence of large disasters that knock out power for extended periods of time in the US and longer wait times before you see your electricity back on. Furthermore, lots of folks have been in situations where grid power is either not available or impractical at the location in need.

Portable solar generators and hybrid emergency backup systems can be solutions to the increasing power reliability issues. However, there are some key points that must be addressed for the success and efficiency of such products.

These critical ideas include the current state of fuel-based generators, trends in solar, understanding kwh and electricity terminology, the benefits of solar power, rethinking your power usage, measuring that usage, incorporating hybrid systems for prolonged activity, and utilizing knowledge to make informed buying decisions.

As members of the Chris Martenson community, we are all becoming educated and aware of the trends in energy pricing and availability, especially in regards to traditional fossil fuel choices. Many of us are witnessing climate change results and extreme weather and its impact on the increasingly fragile nature of our infrastructure, including grid supplied power and liquid fuel supplies.

Traditional Generator Solutions

As a safeguard to these extreme weather events, many people have purchased and used a gasoline, diesel or propane (liquid fuel) portable or fixed generator, to deal with events and blackouts.

There have been many choices and refinements in generator design, and costs have tended to stay down on the lower end products because of Asian imports.

Also, gas fuel prices have remained relatively low, compared to overseas and non-subsidized costs per gallon.

When the power goes out or you need some off-grid power, the easy and entry level choice has been to grab a generator, throw it in your truck or RV, with some fuel cans, and fire it up when you need to run your electric applications. You can get 5 to 7 Kw generators that are still relatively portable, and, when bigger than that is needed, you can put them on a trailer for portability. However, because fuel costs have been low, there has not been much consideration for efficiency or long term costs to running a gas powered generator for extended periods of time.

When gas prices shot up to nearly $5 per gallon in 2008 people started to feel a little pain on this approach, as you only have power when the generator is running, and all generators have some “gallon per hour” consumption figure based on a full or 50% load, which needs to be taken into consideration. Generally, that means you need to keep pouring in the fuel. If you need to run electricity 24/7, that really starts adding up. Plus you have to ensure you have enough fuel to last you through the duration of your emergency or situation. That can sometime be a lot of fuel. You also have to figure in the oil changes and scheduled maintenance by hours run, as well as having to listen to it and smell the fumes coming out all the time.

Moving to Renewal Energy Options

With the price of fuel costs rising and the other factors that make traditional backup energy generation annoying many people, specifically, off-grid residents, started becoming interested in alternative energy systems, especially using solar panels. We have had tremendous upgrades in the technology, design, and usability of components over the last 30 years. This corresponded with drops in pricing, so that there are now many applications of solar energy production installed and in use, with the proverbial

“price per watt” starting to approach traditional grid power choices.

The main approach that people in the off grid world have done is setup their house with a fixed solar array, a battery, controller, and inverter setup. Either you are handy with electrical, and figure it out yourself, or you hire a contractor to do the install. Very typically, an off-grid power setup will include a second charging source or more, in most cases a liquid fuel generator and charger. Some locations will also include a wind turbine and/or a micro hydro turbine for charge input to the batteries.

The arrival of large scale grid–tie solar systems into the mainstream of US households and businesses over the last 7 or so years has been facilitated by cheap, easy grid-tie inverters, net metering, regulatory and utility pricing decisions, and federal and state renewable tax credits and incentives. Unfortunately, there was not much long term thinking in a lot of the large-scale design and redundancy issues, with a very large percentage of newer grid-tie solar installs NOT including an onsite battery backup. The thinking was that the grid is the battery, so do away with customer onsite battery storage issues. But if the grid goes down for any reason, the customer will not have power, even if they have a roof full of solar panels! (Read about a complete solar setup in the WSID Artcle: Installing a Solar Energy System)

There are many situations that have called for a smaller, personal sized solar power system, that is ready to go, plug & play, and portable. These would be used anywhere one would need power, but does not have a grid outlet nearby and it is not appropriate to run a gas generator because of noise, fumes or constant refilling of fuel. Any mobile solar generator device would include PV panel input, charge controller, inverter, and batteries.

The best way to understand how much power and storage you need for emergency backup, or temporary use, is to collect the

wattage of everything that you want to run individually. Then consider for how long it needs to run and add everything up into the “watt-hours”. This basically boils down to “How many watts, for how many hours”. All consideration of solar input and battery storage comes out of that figure.

Here are some practical scenarios to see how this works:

If you are handy, and have done a little mechanical and electrical work before, it's not that hard to put together a small off-grid system yourself, or at least be in the know about how much power you really use or need in a grid failure situation.

The basics:

electric theory 101 > volts x amps = watts

Watts being your power draw, watt-hours is how many watts you need for how long.

You cannot have a consistent power draw with a standalone system without at least double the amount of solar watts coming in. If an application or tool doesn't list watts, but shows amps, you can still figure watts by formula above. Most AC electric uses are at 120 volts.

Here is a simple example of how the math works, for a possible bare bones emergency backup situation at a small home:

Refrigerator (Energy Star) - 250 watts

Lights - 75 watts

TV/Radio - 75 watts

TOTAL - 400 watts

Next, figure out how long your appliances will be on. Refrigerators and freezers will cycle on and off depending on their efficiency, the surrounding temperature, and how many times you open the door. You can get refrigerators and freezers to use less by keeping both of these on a back porch, during times when the temperature is consistently low, and also putting them on a timer or switch, that you turn off at night, as they really don't need to cycle all night to keep the food cold or frozen, especially if you don't open the door. The rest you are in control of when they are on.

For this example, let's say they run for 6 hours per day.

400 watts x 6 hours = 2400 watt-hrs

So we need 2400 watt-hrs worth of power to run our set up for a day. Next, lets take a look at our solar panels. Solar PV power for charging must be in the best south facing exposure, with a minimum of 5 to 6 hours of direct sun, and 8 hrs is even better. If you have 5 hours of full sun on one 200 watt panel, you will have 1000 watt-hrs (5hrs x 200 watts) of power available. If you have cloudy, snowy or rainy days, you will get half that or even 1/4 of that. As you can see one typical PV panel is not enough to run our basic example. You need an absolute minimum of 3 panels, each being 140 to 200 watt PVs.

Next in the setup are the batteries. A single 100 amp-hr battery @ 12volts will give you what seems is 1200 watt-hrs of stored power, when you run it through the inverter, but it's not that simple. To optimize the life of your batteries, they shouldn't be drained more than 50%-60%. So that one battery will give you 600 watt-hrs. Which means at night, running off battery, you will get 600 watts for one hour, or 300 watts for two hours. 4 - 100 amp-hour batteries should give you just enough storage for the samples above.

When it comes to batteries, the more the better. If you ran the loads listed above all night, your batteries would be very depleted, and you would need to charge them up immediately back to full. Hopefully, the sun is shining, and with 5 or 6 hours of 400 to 600 watts of PV input, your batteries would be charged back up. You also would need a good solar controller between the PV panels and the batteries, and a good inverter to take 12 volt DC from the battery, and turn it into AC. It is always a good idea to get an inverter/charger, so if you have some grid power available, or a gas or diesel generator, you can run that for a while, and charge your batteries up, then turn that off and run on batteries for awhile.

Solar power and batteries are no different than gas in a car, as you cannot take more power out of the batteries, than you can put back in with solar charging OR liquid fuel generator power. Having a good voltage meter, PV input meter, and watt-hour meter, and paying attention to these is highly recommended.

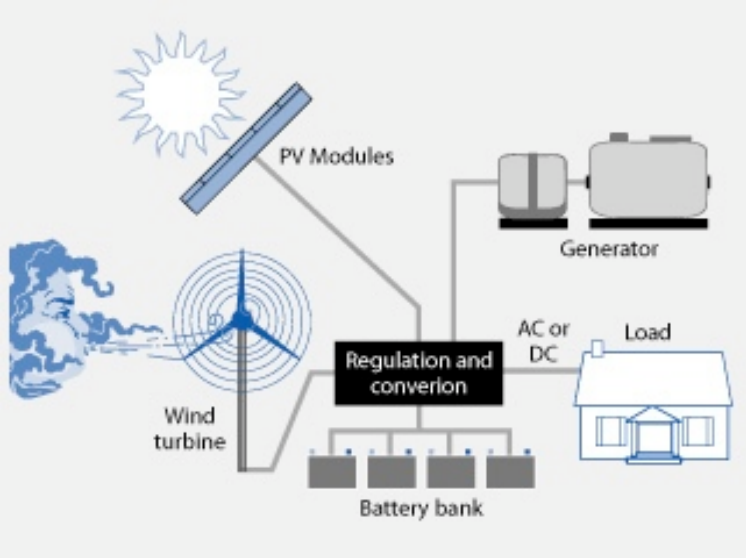
Making sure your battery voltage does not go below 11 volts (for a 12 volt battery setup) for any consistent time will also help prolong battery life.

There is a good rule of thumb for off-grid; very simple and using averages, figure one solar panel + one battery, two PV panels + two batteries, etc.

And whatever you think you will use in wattage, double it.

And what ever you think your need in PV panels and batteries, better double that too.

Hybrid Systems



The solar backup system + a gas or diesel generator (HYBRID system) is really the best way to go, as there WILL be times when your batteries get low and there is no sun to charge it up with. Therefore, you need supplemental power from something else, possibly a small hydro system or windmill, but if you have the generator equipment already, and good fuel storage, then you only need to run it occasionally, and you can make your fuel last much longer that way. Also, good management of a HYBRID system would be to fire up the genny when you need the short, higher bursts of power, like water pumping or bigger tool use. If you plan your solar system accordingly, practice aware power management and efficient use, you can have the free energy from the sun powering most of your critical needs maybe 2/3 or 3/4 of the year.

More complex, expensive and well-designed hybrid systems are setup with the solar, inverter, generator and batteries all inter-tied and on an auto monitor system. This will then remote start the generator whenever battery voltage OR wattage load exceeds certain set thresholds. In most cases, an electrical contractor is called in for these design and install jobs.

(SolMan Mobile Solar Generator)

One advantage of the portable style solar generator systems versus a fixed system (besides being able to take it with you) is that you can position the mobile solar unit in the best sun in your location, then run power cords to your needs. You can also turn the unit to do solar tracking through the day (morning view east, noon view south, afternoon view west) that can increase your daily PV watts output up to 30 % (from 5 hours a day up to 10, if you have the sun exposure).

Considerations and Advice

When considering the economic choices between energy efficiency and energy production, ALWAYS look closely, take action and spend money first on energy efficiency. There is a fairly well tested formula in this business that says for every dollar you spend on energy efficiency, 3 to 4 dollars would be spent on energy creation to match the resulting output or savings.

That means:

- insulate your house
- weather-strip and stop drafts
- upgrade all appliances to Energy Star or better
- use LED light bulbs
- super efficient pumps and motors
- make a wise choice of energy for the job at hand
- practice power management and awareness
- make lifestyle modifications
- get a Kill-A-Watt meter and start measuring exactly what each activity uses
- look at your electric bill and calculate what you use on average every day.

These activities, and the time and dollars you spend to bring your daily use down will ALWAYS cost less than spending that money on more oil or coal power plants, big massive solar farms or onsite solar PV systems, wind mills, diesel or gas generators, hydro dams, nuclear plants, etc, etc.

Now some of that upgrade is costly, granted. The best energy efficient equipment seems to always cost more, but will generally save you more money, AND last longer, in the bigger picture. Certainly the LED lighting story is that way, as the bulbs are extremely expensive right now, compared to incandescent or CFLs. But the energy savings and longevity will more than offset the upfront cost. We have ROI charts for a number of situations that will prove this. Many trends are going in that direction too, including the recurring cost of power. Most economic charts do not have a $$ slot for what it costs you, if you have no power.....

By doing the work of becoming extremely energy efficient, one opens up a whole new window of feasibility to having an

independent or localized power source that is reliable and affordable. This is especially the case with solar and hybrid power generation systems. When looking at a backup/portable power system, keep these points in mind:

- Any solar sales person, consultant, or company that is really doing you a service, needs to start with energy efficiency first, to get your average daily power needs down, BEFORE, they even start calculating how much solar you need.
- I would advise, in these times, to ALWAYS, get a battery backup component to a home solar system if you are considering getting one, or adding that in if you already have a grid-tie system. While the grid-tie systems are great, if the grid goes down, for any length of time, you will be without power, even with a roof full of solar panels (we are seeing more and more consistent longer times to power restorations after storms).
- There are a lot of real cheap plastic so-called solar battery or device chargers or my solar backup, etc, etc. being sold and pushed through TV, catalogs and on the web. Buyer Beware! Many of these are a joke, and will not really work in real life situations to actually and consistently charge your device, or back up your critical needs at home, nor will they last more than a year, before they break or stop working altogether, and then you will throw them away. We have looked at and tested a lot of them, and talked to a lot of other folks using various brands, and the old saying, "you get what you pay for", is never truer. If the solar surface is under 3 square inches, they will just not put out enough electric to really charge your device in a timely fashion. Sure, if you leave your device plugged into them, in the sun for 10 hours or more, maybe they will start to get close to full charge. How real is that?
- If the battery is 50 amp/hrs or under for a home backup system, you will not get more than an hour or two of critical

power usage, before the battery is drained, and will be ruined. **When you really need it, will it fail?**

- The same goes for the "solar LED flashlights". There is some real junk out there. Don't depend on them. Sift carefully, find the quality and "actual value", which is a tool or product that will really work and last, time in and time out.
- There are some good NmH battery chargers, for your AA, C, D etc, cells, that are showing up, that will charge off AC AND a 12 volt DC cigarette lighter plug, which makes them very versatile for having in your car, for all your flashlights, radios, cameras, etc. If you get the 8 or 12 bay models, and fill them up with the main type NmH batteries you use, you will always have fresh batteries that can be cycled in for use and charge. These can also be made to charge off a small solar panel, and so make them even more versatile and power outage proof.

I hope this has been worth it to read through and get a new understanding of how you use power, and how to create some of your own.

The Boy Scout Motto: “Be Prepared”

Chaz Peling

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SolSolutions designs, builds and sells alternative energy, solar electric, and battery backup equipment, and efficient applications, including the SolMan mobile solar generator.

Find us on the web at: **www.sol-solutions.com**

This *What Should I Do?* blog series is intended to surface knowledge and perspective useful to preparing for a future defined by Peak Oil. The content is written by ChrisMartenson.com readers and is based in their own experiences in putting into practice many of the ideas exchanged on this site. If there are topics you'd like to see featured here, or if you have interest in contributing a post in a relevant area of your expertise, please indicate so in our *What Should I Do?* series feedback forum.

If you have not yet seen the other articles in this series, you can find them here:

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- Rainwater Harvesting (BSV)
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- A Case Study in Creating Community (SagerXX)

This series is a companion to this site's free ***What Should I Do?* Guide**, which provides guidance from Chris and the ChrisMartenson.com staff on specific strategies, products, and services that individuals should consider in their preparations.

- What Should I Do? backup blackout electricity Emergency Grid Grid-tied portable power Solar Generator

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