Taking the plunge!

An Off-the-Grid Home Tour to learn the basics of a renewable energy system

by William H. Kemp

I remember the day I popped the "big question" on Lorraine. The anticipation and excitement were now quickly concluding. She was clearly caught off guard. After a moment's pause came the reply, "But can I still use my hairdryer?"

That was her only concern. The rest I was sure, would be easy

Nine years have passed and yes, Lorraine can still use her hairdryer. Living off-grid is both comfortable and satisfying. Our motivation for leaving "life on the grid" was simple. Lorraine wanted to move closer to her family and still have the room and privacy to support her "addiction" to animals. The lot at the back of the family farm fit the bill (and the wallet). There was only one downside: it was about $13,000 from the nearest hydro lines.

My work as an electrical/electronics hydropower engineer made me think: "Why not try to make our own juice?" Surely, I could whip up something for around $13,000. In hindsight, that was a bit naïve, but in the end, our system has grown to the point where it supports our lifestyle and is far more reliable than the power utility. Since that time I have shared my experience and knowledge with dozens of homeowners who have since taken the renewable energy off-grid or grid-interconnected plunge.

What is the trick? A willingness to give it a try and a touch of adventurousness sure, but most of all it's about energy efficiency.

Energy conserving on- or off-grid does not mean you have to live a Spartan lifestyle. A big screen TV, computers, and a cappuccino maker are examples of appliances and devices that are in our off-grid home. Add in the lights and stereo in the horse stable, a hot tub on the deck, garage with electric door openers and you might think that this house is a large electrical consumer. In fact, the opposite is true. We operate our house on between 3 to 6 kWh per day, depending on the season. Contrast this with other homes that use 40 to 75 kWh per day.

An energy efficient house has much of the same "stuff" as a regular house, but it uses 10 times less electricity than the average home. Before you run off saying, "Yes, but all the expensive appliances to operate use propane", remember that most people use natural gas for the majority of their large loads, and dollar-for-dollar, electricity is the most expensive way to make heat. Ask someone who just paid his or her electric heating bill for this past winter.

Let’s look at some of the most obvious design features that can be incorporated into a building design, regardless of whether or not it is off the electrical grid.

Design for Solar Heating (and Cooling):

Orient the house to accept as much solar gain as possible during the winter months. This generally means orienting the house’s long axis to face “solar south”. Minimize glazing on the northern side of the house. Ensure the low winter sun can penetrate as far into the house as possible. Likewise, ensure the higher summer sun angle is blocked from entering the house by using roof overhangs and the leaves of deciduous trees. Following these rules will reduce heating and cooling loads, making the house more comfortable all year round.

Figure 3 Orient the house to take advantage of winter solar gain and summer shading.

Build for Your Local Weather:
Your local building code is the minimum requirement used to design a house. You can do better. Building a tight, well-insulated home with well-sealed wind and vapor barriers will pay for itself many times over. A well-constructed house will not only be less expensive to heat, it will also be much easier to cool and control humidity levels. Use high quality insulation materials such as spray packed cellulose. Watch out for problem areas such as rim joists, where fiberglass and polyethylene don’t work well. In those areas, use spray urethane foams that have excellent R-values and provide an integral vapor barrier seal.

Ensure that doors and windows fit properly and air leakage throughout the house is well controlled.

Control Fresh Air Intake:
A well-sealed house is like living inside of a plastic bag. Fresh air needs to be circulated within the house to ensure clean air and to control humidity. Your Municipal Building Code may require the use of such items as a Heat Recovery Ventilator. Determine if they are necessary or if they can be replaced by a passive “air circulation plan” designed by your heating contractor. HRVs have a place in society, but not in an off-grid house, because of their high electrical load.

Design the Heating/Cooling System:
Assuming you are building a rural home, design the primary heating system around a high quality, catalytic or ultra-high efficiency wood stove. These units are a far cry from Grandpa’s stove, the ones that seemed to need constant feeding, especially in the middle of the night. Modern units are approved for safe operation, meet EPA requirements for smoke output and only require feeding a couple of times per day. Our home uses roughly two cords of wood (a cord is 4x4x8 feet of tightly packed wood) per heating season. Another reason for using wood is that the heat it generates can be distributed throughout the house by convection, without the need for a central furnace. What, no furnace? That’s right. That $5,000 box in the basement uses a circulating fan that eats up far too much energy. A wood stove, possibly mixed with some high-efficiency, direct current ceiling fans, will easily heat any house and be easy on your off-grid system at the same time.

Figure 4 Active solar heating, propane fireplaces and freestanding units such as this model that require no electricity and can be sized to meet the heating requirements of any home. They also look a lot better than the $5,000 furnace in the basement.

What happens when you are away? Rather than missing the trip to the in-laws at New Years, install a propane fireplace or freestanding unit (high-efficiency of course) similar to the one shown in Figure 4. Not only do these modern units not require any electricity, they can be sized to heat any home. Besides, they are a lot nicer to look at than the old furnace in the basement.

Cooling is another story. Central air conditioning is by far one of the largest and least efficient loads in the home. It does not belong in an off-grid home. The best way to keep your home cool is to stop the heat from getting inside in the first place. This might sound simplistic, however, a well insulated home, with shading that blocks the summer sun from entering the house will go a long way to prevent overheating. Let the prevailing breezes cool the house at night by opening the windows that face it and those on the opposite sides of the house.

When the mercury and humidity rise, even the best built house will need a little help. For those of you lucky enough to have relative humidity levels below 30% in the summer, an evaporative cooling unit may be the ticket. These devices are very common in the U.S. South-West and use very little electrical energy to boot. A one-ton (12,000 btu) per 1,500 square foot, high efficiency window style air conditioner may also help. In our house, one unit is installed on the main floor with a second installed in the bedroom area upstairs. Both units are permanently mounted into the walls, with the condenser (the part outside) facing as far north as possible, out of direct sunlight. Although these units are very large loads on the off-grid system, they are just the ticket to bring the humidity and temperature down to a comfortable level. Every A/C installer will swear up and down that this size is too small. If you are the sort who needs to wear a nice wool cardigan in your house in July, then maybe they are right. For the energy conserver, this size works quite well.

Technically speaking, most A/C systems are sized far larger than needed. This is usually an effort to make sure that “you are getting what you paid for”, a very fast, obvious cooling of the indoor air. It also ensures you don’t call the installer back because the A/C isn’t working well. On the other side of the coin, a large unit cools the air, but does not have sufficient time to reduce indoor humidity levels. A smaller unit running a bit longer will ensure lower indoor humidity, greatly improving comfort. One big plus for these smaller A/C units is they tend to be used only when there is a surplus of energy. Normally this occurs on those long, hot summer days that make the PV panels so happy.

A Look Inside:

Unless you are the sort who gets excited about dimensional lumber and sheeting material, the structural stuff will be contracted out. Inside the house, you can influence every Watt of electricity that you use and actually see and measure where it goes. We will review a little bit of the math, to help you understand how it all works. This will also help explain those cryptic power bills.

Almost everyone has heard that compact florescent lamps (CF lamps) last longer and are cheaper to operate than regular light bulbs. Lets examine the difference between the two. Understand that every appliance in the home, consumes electricity in the same way, albeit at different rates.

Figure 5. The compact florescent (CF) lamp is the bulb of choice in the modern, energy efficient home. A standard incandescent 60-Watt style is on the left. The others are different styles of compact fluorescent bulbs. A typical 15 Watt CF lamp is as bright as a standard 60-Watt Incandescent.

The Watt is a unit of electrical power that is calculated by multiplying the Voltage (or pressure of the electricity) of the appliance (typically 120 Volts) by the current in Amps (or flow) of electricity through it at a given instant. The more Watts an appliance requires to operate the more electricity it consumes. You do not pay for power (or Watts). Your electrical bill is for energy, which is simply Watts of electricity consumed multiplied by the amount of time the appliance is on.

Lets try an example. Bear with me, this is not too difficult and is quite important!

Assume that our 60-Watt standard bulb is turned on for 10 hours. What is the energy consumed?

60 Watts (of power) x 10 hours = 600 Watt-hours (of energy)

Now, electricity delivered to your door, with all of the nice additional charges that the government can find is about 10 cents per 1,000 Watt hours (or 1 kilo-Watt hour, kWh.):

600 Watt-hours (of energy) x $0.10 per 1kilo-Watt hour = $0.06 or 6 cents

If we run the same equation for the 15 Watt CF lamp, we will find the cost to be 4 times lower, owing to its lower energy consumption, or 1.5 cents.

This is not a great deal of money, but when you add up each electrical appliance's energy consumption over the course of a month, the bill can become quite high. (Check out peak daytime rates for electricity in California).

The general rule for an off-grid house is to purchase the most efficient appliances you can reasonably afford. It is also important to keep high electrical energy consuming appliances such as electric stoves, electric clothes dryers, space heaters, and the like, off the list.

Figure 6 A standard Sears 18.5 Cubic foot, 2-door refrigerator like this one will save hundreds of dollars and kilowatt-hours of energy over its 20+ year operating life.

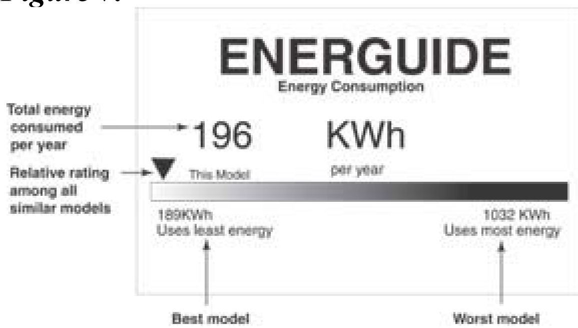
The typical home refrigerator is a large consumer of electricity. Recent advances in appliance design have lowered electrical consumption by more than half. Our Kenmore 22 cubic foot, 2 door unit, uses only 435 kWh of electricity per year, which is 1,200 Watt hours per day, (12 cents at current rates) according to EnergyGuide ratings. All major home appliances have the EnergyGuide rating and they should be compared before purchasing any appliance. This is especially true for off-grid installations.

Large heat producing appliances that use electricity do not belong in an off-grid house because of the enormous amount of energy they consume. This applies to ovens, stoves, clothes dryers, space and water heaters, car block heaters, etc. The clothes dryer shown in Figure 7 is an example of a modern efficient appliance. The heating source is propane gas. In the typical off-grid house, propane gas fired appliances will be used for the bulk of the heating functions.

Figure 7 This Sears high efficiency clothes washer uses five-and-a-half times less energy than a similar sized unit. Coupled with the propane dryer to the left, this makes an excellent choice for any renewable energy based home.

Other large appliances found in our home include: propane cooking stove, propane water heater (either storage or on-demand types can be used), high-efficiency, front loading washing machine and central vacuum system.

Figure 8 The EnergyGuide in the U.S. and EnerGuide in Canada labels allow for easy energy consumption comparison between appliances. This label belongs to the washing machine shown in Figure 7.



The same basic rules apply to most home office/computer installations. Laptop computers with ink jet printers are the best. Replace the old picture tube monitor with a flat screen LCD unit and save big time (just the excuse you needed for the upgrade). Laser printers tend to be the worst office equipment electrical load. Just make sure you switch it off after you use it. The Government has come to our aid by creating a program similar to EnerGuide for use with data processing equipment. This program, called Energy Star, ensures that complying devices go to low power mode when sitting idle.

Figure 9 Purchasing computer, home office and stereo equipment with the Energy Star label ensures the lowest energy usage appliances

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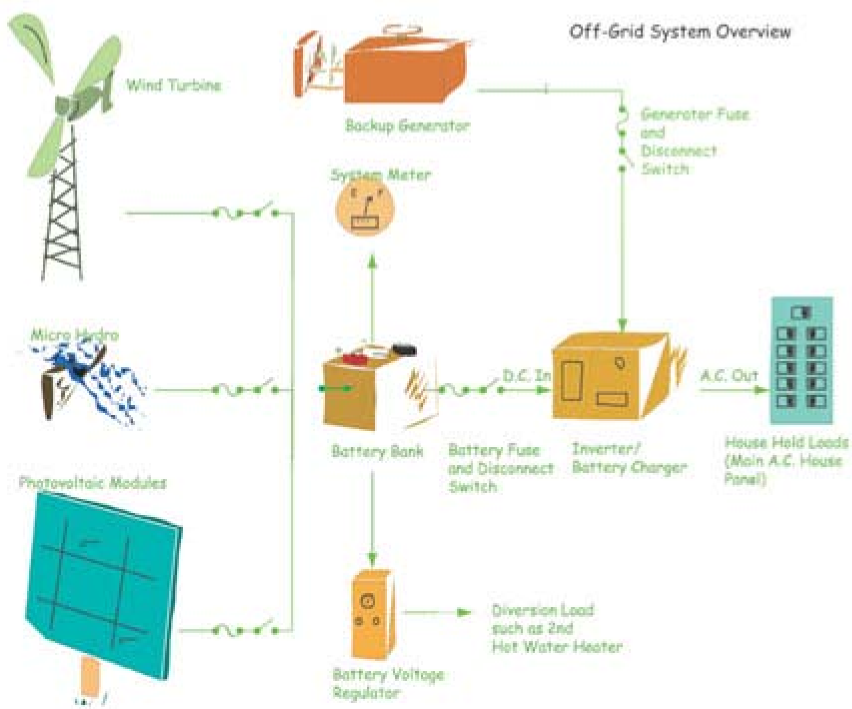
Money Isn't All You're Saving

The Fun Stuff - Making Electricity

We now know how to stretch our electrical energy dollar further and live within the means of an off-grid system. Let's see how to make the energy that we need to run a household. It should be obvious if we consume 3 to 6 kWh per day, we need to produce about that much too.



All off-grid systems work much in the same fashion. Collect energy from a renewable source (wind, sun, and/or stream), convert it to electricity and store the energy, usually in a battery bank. When we need this energy to power our appliances, we take some of the energy from the battery, convert it to alternating current (just like the power utility) and feed it to our unsuspecting appliances. Most off-grid systems also contain a backup power source, usually in the form of a propane, gasoline or diesel generator or genset for short. These units supply power to charge the battery bank in periods when the renewable system is not able to support the necessary electrical loads.

On-grid or grid-interconnected systems are very similar to off-grid systems. The renewable energy is fed directly to the inverter and converted into alternating current, which in turn supplies the grid. If you produce more energy than you require, the surplus is sold to the grid, so that your neighbor down the street can also use some. Selling energy causes your electrical meter to run backwards, providing you with a credit in your electrical energy "bank account". When you require more energy than you are producing, the electrical grid supplies you with "make up" energy causing your meter to debit your account in the normal manner. Every once in a while, your utility will send you a statement indicating whether you owe money or the present balance in your energy account is positive. The selling of electrical energy back and forth is called net metering. It is the law in many North American jurisdictions, requiring the utility to purchase your excess energy at the same retail price you pay for theirs. This really is a great deal.

Grid-interconnected systems do not require a battery bank and voltage regulation equipment, or backup generation. This lowers the installed cost of the equipment as compared to off-grid systems. On the other hand, if you have no batteries or backup generation source, your home will be just as dark as your neighbor’s during the next electrical blackout.

In theory, it seems simple, but just like everything else in life, the devil is in the details. Look at the overview shown in Figure 10 and lets follow the system through its operation.

All of the earth's energy comes from the sun. In the case of renewable energy sources and how we harness that solar energy, the link is often very clear: sunlight shining through a window or on a solar heating panel creates warmth, and when it strikes a photovoltaic (or PV) panel the sunlight is converted directly into electricity; the sun's energy causes the winds to blow, which moves the blades of a wind turbine, causing a generator shaft to spin and produce electricity; the sun evaporates water and forms the clouds in the sky from which the water, in the form of raindrops, falls back to earth. The rain falling in the mountains becomes a stream that runs down hill into a micro hydroelectric generator.

While these energy sources are renewable, they are also variable and intermittent. In order to ensure that electricity is available when we need it, a series of wire cables, fuses and disconnect switches delivers the energy to a battery storage bank.

Although there are many different types of storage batteries in use, the most common and reliable by far is the deep-cycle, lead-acid battery. You may be familiar with smaller ones used in golf carts or warehouse forklift trucks. Batteries allow you to store energy when there is a surplus and hand it out when you are a bit short. So why are we using a battery bank? What other means do we have to store electricity?

Great questions, simple answer: There just is not any other feasible method of storing electrical energy. Maybe down the road, but if you want an off-grid system now, batteries are the only way to go. Today's industrial deep cycle batteries are a solid investment that should last 20 years with a minimum amount of care. At the end of their life, old batteries are recycled (giving you back a portion of their value) and new ones are installed.

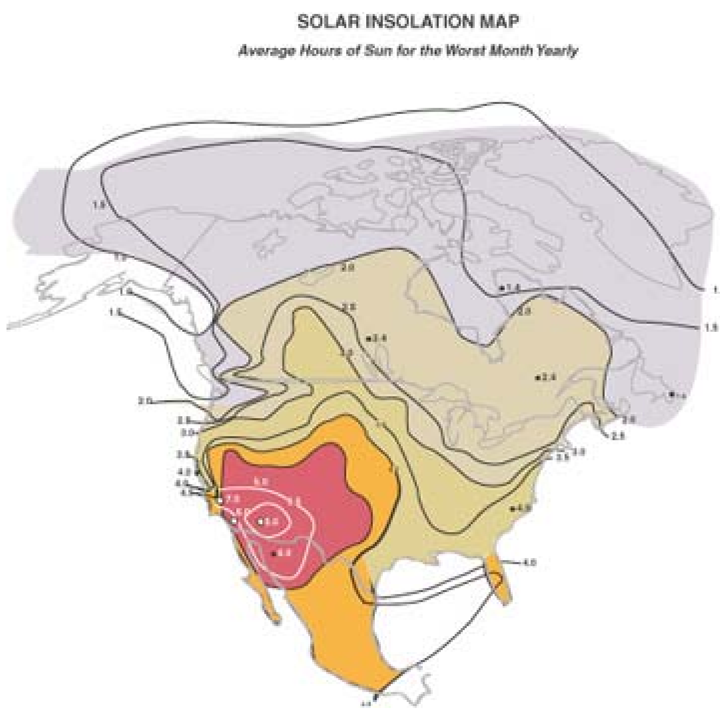
Storing electrical energy is simple: just connect the renewable energy source to the battery and away it goes. Getting it out is a bit more complex. First, electricity is stored in a battery at a low voltage or pressure. You probably know that most of your household appliances use 120 Volts, whereas off-grid batteries commonly store electricity at 12, 24, or 48 Volts. The electricity stored in a battery is in a direct current (DC) form. This means that electricity flows directly from one terminal to the other terminal of the battery. Direct current loads and batteries are easily identified by a red "+" and black "-" symbol marked near the electrical terminals.

The electricity supplied by the utility to your home is alternating current (AC). This means the direction of flow on the supply wires changes direction at a rate of 60 cycles per second or 60 Hertz.

In order to increase the voltage (pressure) of the electricity stored in the batteries and convert it from DC to AC, a device known as an inverter is required. Without an inverter, your choices in electrical appliances and lighting would be reduced to whatever 12 Volt appliances you could find at the local RV store. Early off-gridders did in fact choose this path, but do not consider it for anything but the smallest of summer cabins or camps. A house full of middle class dreams means a house full of 120 Volt, AC appliances. Standard electrical power also means standard wiring, standard electricians and happy electrical inspectors who enforce safety standards.

The information provided in this primer describes a basic system. A supply of electrical energy from wind, water, or sunlight feeds low voltage electricity into a battery bank. The batteries store the electrical energy within the chemistry of the battery "cells". When an electrical load requires energy to operate, current flows from the battery and/or the renewable energy source at low voltage to the inverter. The inverter transforms the DC low voltage to AC higher voltage to feed the house electrical panel and the waiting appliances.

The Changing Seasons
As a bad July sunburn will remind you, the amount of sunlight in summer is much greater than in winter. Simply put, the longer the sun's rays hit a PV panel, the more electricity the panel will push into the battery. The months of November and December tend to be dark and dreary by contrast. How does this affect the system and will there be enough energy in the winter?



Seasonal variability is extreme in the northeastern section of North America. The amount of sunlight shining in December is approximately half as much as is shining in September, and even less than in June. Obviously, the PV panels' output reduces accordingly, and the amount of stored energy varies with it. This creates an odd paradox. There is too much electricity in summer and not enough in November and December. How do we design around this problem?

Hybrids (Winter Season)
Hybrid design simply means adding more than one source into our energy mix. In our overview example, we have PV, wind and micro hydro, plus a backup generator. This design is not typical, as most off-grid systems typically start with PV as the main renewable source, a backup generator second and possibly a wind turbine third. For those of you lucky enough to have a year-round stream sufficient to operate a micro hydro system, that may be the only energy source you will require.

Grid-interconnected systems are typically PV based. Wind and water based sources are not commonly grid-connected, owing to the rural nature of these energy sources.

Back to watts and nuts and bolts for a second. Remember that we talked about consuming 3 to 6 kWh of electricity per day. Now we have to look at what we produce, to see how well they even out. Our PV panels' rating is 1200 Watts peak-power output (28 Volts x 43 Amps DC). In reality, they tend to output approximately 950 Watts under ideal conditions, less if it is hazy and nearly zero if the day is cloudy. The entire assembly is mounted on a sun tracker unit, which allows the panels to face the sun as it moves from early morning through late afternoon, winter and summer.

The worst amount of sunlight for our location provides an average of 2.2 sun hours per day:

2.2 sun hours per day x 950 Watts output = 2,090 Watt-hours per day or approximately 2 kWh per day

With 2 kWh of production and an average consumption of 4 kWh per day, the system will loose 2,000 Watt-hours per day. If this was your bank account and you kept taking out more money than you put in, guess what happens? Depending on how deep your pockets are, you run out of cash. The off-grid system batteries are no different. In fact, normal battery sizing assumes that you should be able to run your house "normally" for 3 to 5 days without having any input from your renewable energy sources. For our household, running average loads means the batteries need to supply:

5 days supply x 4 kilowatt-hours per day = 20 kilowatt-hours usable capacity

So, what happens at the end of 4 days? This is where the hybrid design comes in, you either have another renewable source pickup some of the load or rely on your backup genset. Depending on the degree of automation in your system, you either manually start the backup generator (gas, diesel or propane) or a generator control device starts the generator for you. In either case, the inverter now switches to battery charging mode and fills the batteries back up. The house electrical loads automatically receive power from the generator during this charging time. Once the batteries have reached full charge, the generator turns off automatically or you run out in your housecoat and slippers to shut it down. (I think the automatic feature is definitely worth the few extra bucks!)

If your system contains more than one renewable source, you will find that they tend to be complementary. A dull day in November often has brisk winds and, conversely, the air on a sunny summer day is hot, still and stifling. However, do not believe that having PV and wind will eliminate the need for a backup generator; it will not. The combination will reduce the running hours of the generator considerably, but it will not eliminate its necessity. Our house still requires over 100 hours of generator time per year.

Hybrids (Summer Season)
During the summer months, the increase in sunlight hours, coupled with a lower need for lighting and less time spent indoors creates a surplus of energy based on consumption levels at 3.5 kWh per day.

Production:
6.0 sun hours per day x 950 Watts output = 5,700 Watt-hours per day
or approximately 6 kWh per day
Surplus:
6 kWh/day produced - 3.5 kWh/day used = 2.5 kWh/day surplus

We may or may not need this surplus, depending on whether or not we require any air conditioning that day. As mentioned earlier, an air conditioning unit uses an enormous amount of energy, approximately 1,100 Watts per hour operated. Based on a surplus of 2.5kWhr/day, we should be able to operate the air conditioner for up to 2.5 hours per day, without dipping into the energy bank.

On days that we do not need the air conditioning, the surplus energy produced must go somewhere. You must consume this energy or the batteries would reach a fully charged state and would eventually "overcharge". To prevent this from happening, a battery voltage regulator connects to a diversion load. A typical diversion load consists of an electric water heater, plumbed "before" the regular gas water heater. Converting the electric water heater to the same voltage rating as your battery bank makes the diversion load (24 Volts in our home).

While operating, the battery voltage regulator monitors the battery voltage or state of charge. When the batteries become fully charged, the regulator starts to divert surplus electricity to the electric water heater. The water starts to heat as it absorbs the extra energy produced by the renewable energy sources. Over the course of a day or two, the water can easily reach 140 degrees F. (60 C.), which in turn flows into the regular gas water heater. As the incoming water is already hot, the gas heater remains on standby, thus conserving propane gas, energy dollars and the environment; energy is never wasted in this system!

Phantom Loads

As the name implies, phantom loads are any electrical loads that are not doing immediate work for you. This includes items such as doorbells (did you know that your door bell is always turned on, waiting for someone to push the button?), "instant on" televisions with remote controls, clock radios, and power adapters.

So, what is the big deal? First, these devices are consuming energy without doing anything for you. That electric toothbrush was probably charged about 15 minutes after you put it back in the holder. The remaining 23 hours and 45 minutes until the next time you use it represents wasted energy. A television set that uses a remote control is actually "mostly on" all the time, just waiting to receive the "on" command from your remote.


While the total dollar cost for these luxuries is small on-grid (around $10.00 per month for an average house), this consumption off-grid is unacceptable. By the way, this "small" bit of waste equals quite a few million dollars a month in North America alone.

Another reason for the concern about phantom loads in off-grid installations is the inverter unit waste. This device goes into a sleep mode when the last light is turned off at night, conserving a fair amount more energy. Any phantom load keeps the inverter "awake" consuming more energy than it otherwise would.

Phantom Load Management

Some phantom loads can simply be eliminated. Try a doorknocker instead of a doorbell and a battery-powered digital clock instead of the plug-in model. I have even heard that some people use manual toothbrushes.

Television sets and CD, DVD, and VHS players with instant on and remote control functions should be wired to outlets that can be switched off. This could mean having the electrician wire in the switch for you or using a power bar with an integral switch.

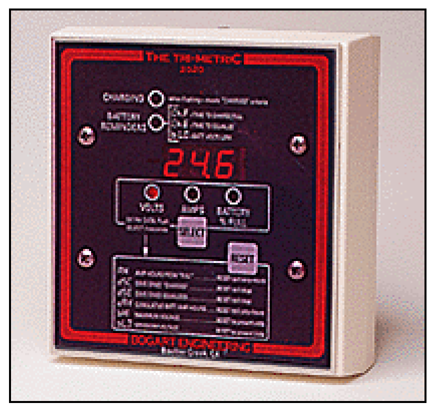
Many people cannot live without some phantom loads such as a fax machine, cordless phone, cell phone, PDA and laptop chargers. For these items, use a separate wiring circuit run through the house, which connects to specially marked outlets. These outlets are reserved for ESSENTIAL "always on" loads like the ones described above.

The power for these outlets comes from an inexpensive, 100-Watt inverter that is wired directly to the batteries. Such an arrangement ensures the main inverter can go to sleep at night and still provide power for the small devices you desire. If your home is already built, it may be possible to group all of these special loads at one central location and run the inverter to a power bar at that point.

Take note about this "small" inverter powering phantom loads. If you load it up with all of your toys, it is possible to burn up nearly 100 Watts of power. Over the course of 24 hours, this is a lot of juice:
100 Watts x 24 hours per day = 2,400 Watt-hours or 2.4kWh

A load of 2.4 kWh is almost half of most renewable-energy systems' daily total energy production; tread lightly!

Metering and Such
At this point you are probably wondering if I run around the house with a note pad and calculator, chastising Lorraine for using her hair dryer too long or making the toast too dark, while recording every volt and who knows watt. Actually, we hardly look at the system at all. Once you install your system and load the house with all the electrical goodies imaginable, within your average production limits, the system will almost take care of itself. If we use more energy than we produce, the generator may run for a while. If we make more energy than we use, the next shower is free due to the savings in hot water. The system is almost invisible.



For grid-interconnected designs, the system is invisible. The only notification you get that all is well is a statement from the utility advising you that you have a $500.00 credit.

As with any piece of complex machinery, a bit of care and management is required. I would include a multi-function meter in the mix. This unit monitors the energy produced and consumed, and calculates all the nasty mathematics necessary to tell you how much juice is really in the battery. By monitoring the meter and other data, you will have a comprehensive snapshot of the health of your own power station.

Is it Economical?
This is a tough question, because the answer is not straightforward. Let's start by looking at an off-grid system. The cost of a turnkey (i.e. you do none of the installation work), off-grid PV-based system running house loads similar to ours is about $12,000 to $18,000 for all of the materials and installation labor. Do some of the work yourself and it can be lower. Add a wind turbine and, of course, the cost

increases. Can you work with used equipment and do you like to tinker around? Can you live with smaller or fewer electrical loads? Swap a 15 inch TV for the big screen, use regular telephones, charge the cell phone in the car, there are a million ways to lower your loads and system costs. If you do not do any energy conservation, expect to pay between five and ten times the amounts discussed. (Once again, energy conservation is important!)

How far the installation is from the hydro grid determines the break-even point for most off-grid homeowners. If your hydro utility is more than a half mile (0.8 km) from your house, it may pay for itself from the second you turn on the first light. You can also add to that the benefits of no hydro bill, zero environmental pollution and the feeling of self-sufficiency you get the next time your neighbor's lights go out during that dark and stormy night.

Will your private power system remain connected to the electrical grid? If so, the installed rate will tend to be lower, because of fewer equipment requirements. Remember that you will not require a battery bank, voltage regulator, battery compartment and many other components. On the other hand, most grid-interconnected systems tend to be larger than off-grid units. What leads to this apparent contradiction?

Connecting a renewable energy system to the grid is not currently economical at all, environmental issues aside. Why bother hooking up expensive equipment to the grid, when the payback period is dozens of years, if ever. Most people are not so committed to conservation that they are willing to spend loads of cash just to help the environment. The answer is net metering and subsidized paybacks in the form of capital equipment rebates. We discussed net metering above. This program allows you to sell power back to the utility at the same retail price you pay. Net metering laws are springing up all over the planet and for good reason. Electrical power from centralized fossil fuel plants is becoming an albatross that needs removing from society's neck. Power brownouts in California, grid disruption along the north east coast and damaging ice storms are all reasons why governments wish to encourage distributed electrical generation. Never mind the environmental concerns which speak for themselves.

At the time of writing this primer, California has the best support program to encourage renewable energy, distributed generation of electricity. The program is the "Emerging Renewables Buy down Program", which provides a cash rebate for up to 50% of the cost of these systems. One typical system having 2,500 Watts of PV, grid-interconnected, after rebate costs $7,500.00. Payback periods with these rates are not much different from typical energy efficient appliances.

Use care when calculating system payback. Do not assume you can use your current rate of electrical consumption in the payback equation. Just because your home is grid-interconnected does not mean that you should forego energy conservation. It is better to spend one dollar on high-efficiency equipment to reduce loads than it is to spend five dollars on renewable energy production. The payback on renewable generation equipment will look worse once you have reduced your electrical loads by 5 or 10 times.