Living on 12 volt solar power for zero EMF

Part 1 — Introduction

People who are sensitive to electricity and electromagnetic fields may benefit greatly from living in a house that does not have regular utility service. Some people have taken their homes off the utility grid while others have moved to an area beyond any utility service and bought or built an off-grid home.

Some people have a hybrid, where the house is off the grid, while a garage/outbuilding is on the grid with various appliances inside.

This multi-part article discusses the many things to consider when living off the grid, such as appliances and how to grow your own power.

Keywords: off-grid, 12 volt solar, DC electricity, why live off-grid, benefit, drawback, how to, low EMF, health, inverters, dirty electricity

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The other parts of this article covers the specific technologies needed, such as solar panels, batteries, 12 volt appliances, wiring, etc.

1. Benefits and drawbacks to living off the grid

Building a 12 volt rural solar powered house has several possible advantages, including:

- land is much cheaper to buy in areas without utility power
- fewer neighbors
- slow growth
- quieter area to live in
- many health benefits
- fewer (or no) power outages

The health benefits may include:

- no utility lines
- no utility Smart Meters
- no magnetic radiation from household wires
- reduced or zero ground currents
- no dirty electricity
- low electrical field (12 volt)
- cell towers usually require grid power and thus won't be erected nearby
- less development may mean less air pollution

There are several drawbacks to off-grid living, which must be carefully considered. It is a major change in lifestyle, one which some people may never be happy with, though others are quite satisfied with it (including this author).

The drawbacks to off-grid living may include:

- cooking must be done using gas, usually on an outdoor stove and grill
- less convenient lifestyle
- members of household may object to lifestyle
- more user involvement in the house operation

The drawbacks to off-grid country living may include:

- difficult to obtain financing from banks
- telephone land line may not be available
- no trash service (haul yourself)
- agricultural spraying
- awful industry (pig farms, mining, power plants, etc.) seek out rural areas with few people

- isolated living
- more driving, unpaved roads

In some cases, it only makes sense to go off-grid in a rural area. In a city, town or suburbia, the electropollution and toxic drift from the neighbors will still be there. The electropollution will most likely include cell phones, wireless networks, stray currents in the soil and much more. Not much may be gained by removing the house from the electrical grid.

The exception may be for those who are very sensitive to the electrical field itself (as opposed to the magnetic fields, which are more commonly the problem). Another exception can be to avoid smart meters.

Living off-grid in a rural area is definitely not for everyone. People who require push-button convenience are not good candidates. There must be a true willingness to make changes to the lifestyle and to do without some common conveniences, such as those listed in the next section. However, once settled in, you may find the changes to be worth it. The better health and a calmer country lifestyle may be a pleasant result.

Off-grid living doesn't need to be a hardy life of chopping wood and freezing in the dark, as some people seem to think. There are a few people living that way, but most off-gridders have all the important conveniences of a modern life, such as indoor plumbing, hot water, electric lights, a washing machine, refrigerator, radio, thermostat-controlled heating, etc.

If you find this document too technical, off-grid living is probably not for you. It does not require many mechanical skills to live off-grid, but you must be able to understand how the system works, and be able to start a generator.

You will also need to have the mindfulness to always conserve energy; to live within the limits of the system. Turning off what is not needed must become second nature. This includes keeping an eye on the weather to know how much power is available and perhaps use very little on dark winter days.

Some people are forgetful and may leave the lights on in the bathroom or on the porch. This can be a problem with a small solar system.

The system should have a voltmeter, which you'll need to learn to read, and glance at throughout the day, just as drivers glance at the dashboard of a car.

It is essential to accept that in an off-grid house, electricity and water are not unlimited, like they are in a grid-connected house. They may not be rationed, but

leaving the lights on everywhere in the house and taking 30-minute showers every day may not be possible. If the system is very small, such as in a camping trailer or a small cabin, it may be necessary to be very frugal with the resources.

People living in an off-grid house must have the presence of mind, and basic understanding of the system, to notice if the system needs maintenance. For instance, if the toilet leaks, so the pump goes on a lot, that must be taken care of so the batteries are not run down. During winter storms, electricity must be conserved more than usual, or the generator must be run to charge the batteries.

It does not take an engineering degree to live comfortably off the grid, nor does it take a lot of physical strength. There are several single women and retired people who live off the grid. A well-designed solar system may only need minor maintenance every few months, which does not require a strong person. Aside from changing the batteries (typically once every four years), the most physically demanding task might be to broom the snow off the solar panels. In some cases, it will be necessary to run a generator during dark winter days..

If you find that recycling, washing dishes by hand and using a clothesline is a real burden, this lifestyle is probably not for you. People with chronic fatigue and other mobility issues may simply not be able to do those chores. People who have never had to wash dishes and dry clothes on a clothesline may feel intimidated, and that it is a step back in time — those folks will have to decide whether minor effort is worth the possible benefits to them. Living off-grid requires that all members of the household cooperate. It only takes one person to sabotage the system.

2. Why use 12 volt DC electricity?

A normal American house is served by 120 volt AC (alternating current) electricity, which comes from a local utility company. The electricity cycles back and forth (alternates) 60 times a second (in Europe and elsewhere, they use 230 volts and 50 cycles). This cycling of the power generates a pulsing magnetic field (EMF) around the wires in the walls and the cords plugged into the outlets. This field grows with increasing current.

A 600 watt space heater generates a field around the wires that is ten times as strong as a 60 watt light bulb. This field will be the same strength all the way along the cable inside the wall, back to the breaker box. The wall does not dampen this field at all (unless it's a metal wall). If there are other electrical users on the same circuit, their magnetic fields add up. I.e., if there are two 60 watt light bulbs, the field around the cable is twice as large as if there were only one 60 watt light bulb.

Some researchers believe that a cycling magnetic field affects the cells in our bodies. The inner components of the cells simply vibrate in lockstep with the field, as it changes direction 50 or 60 times a second. If the electricity also contains additional frequencies, called "dirty electricity", the pressure on the human cells increases.

With pure DC electricity (direct current), there is no cycling or pulsing field. Pure DC is simply healthier for humans.

The earliest electrical grids in New York City, set up by Thomas Edison around 1890, used DC electricity. But AC electricity soon took over, as it was much easier to transport over long distances, through the use of high voltage transformers.

Twelve volt DC electricity has a very weak electrical field, compared to the 120 volt/230 volt fields from the standard household system. The electrical fields from 120 volt/230 volt wiring can be largely eliminated by putting the wiring in steel conduit, as an alternative to go low voltage.

It is seldom that people are sensitive to the electrical field and not the magnetic field of household wiring. Many people appear to only be sensitive to the magnetic field.

2.1 Dirty DC electricity

It is a common misunderstanding that all DC electricity and all DC appliances are healthier than their AC counterparts. It is not that simple. DC appliances can radiate EMF as well. A cell phone is a DC appliance, for instance. So is a computer, inside the box.

Some electronics, such as radios and televisions, may be better tolerated when run from DC electricity. This is because the power supply that turns regular 120 volt (or 230 volt) AC into low voltage DC is omitted. It itself is usually a major source of radiation and dirty electricity. However, most electronics still create problems.

Appliances that use motors are usually *more* troublesome when run on DC electricity. Typical examples are fans, swamp coolers, pumps, dust busters and electric refrigerators. Their DC motors emit much more electromagnetic radiation than AC motors do, it is an inherent effect of how the two types of motors function. The result is that sensitive people need a greater safety distance from DC motors.

Appliances using DC motors and/or electronics will backfeed high frequency signals onto the wires in a house (just as AC appliances do). These signals can be strong (especially those from brushed DC motors), and a sensitive person may pick them up anywhere in the house (an AM radio may also).

It is possible to dampen the magnetic fields by using twisted cables throughout the house. Simple filters can also be used. A better option is to avoid problematic DC appliances, as described later in these articles.

2.2 The problem with inverters

Modern solar electric systems generate AC electricity so the household can use regular appliances and electronics. It may also sell AC power back to the electrical grid.

Solar panels always generate DC electricity. It is then converted into AC electricity using an inverter. An inverter works by chopping the DC electricity up thousands of times a second (the workings of an inverter are too complicated to describe in a short space). This chopping generates thousands of electrical spikes every second. This dirty electricity travels on the wires throughout the house and can usually be picked up as static on an AM radio, even when outside the house. These radio frequency emissions are a problem for very sensitive people.

A more objective way to measure it is with a Stetzer Microsurge Meter. It is likely to go off its scale.

Any inverter will emit radio frequency EMF; even the best quality sine wave or square wave inverter available. Newer models of the more expensive inverters are better, but may not be good enough.

3.3 How about 24 volt?

It is possible to use 24 volt instead of 12 volt. There are some advantages to a higher voltage when building a large system with a large battery bank. Large solar panels are also usually 24 volt. Some pumps, refrigerators and a few light bulbs are available in 24 volt versions. If you plan for a system with more than 1000 watts of solar panels, 24 volt is probably a good idea. However, with 24 volt there will be fewer choices and things may become more complicated. There are devices called DC–DC converters which can link 12 and 24 volt components in a system, but they radiate radio-frequency EMF.

We'll discuss 24 and 12/24 volt systems throughout these articles.

If there is no compelling reason to use 24 volt, it is best avoided. A 12 volt system should be fully adequate for most low-EMF households.

3. What can 12 volt systems do and not do?

The 12 volt system was a mainstay of solar homes for decades. The 12 volts came from the automotive industry, as they already used that in cars and RVs. It is also commonly used in boats. Today, 24 and 48 volt are also used, but generally only for systems with inverters.

There are many choices available in light bulbs, radios, fans, water pumps, refrigerators and even small hair dryers and evaporative coolers for 12 volt DC. These tend to be more expensive than the mainstream models, and some models are only designed for occasional camping use and are not durable enough to use daily.

Electrical motors for DC electricity send out more EMF than AC motors, so sensitive people should not use DC-powered refrigerators, fans or pumps in the house. These may be fine in an outbuilding.

Most laptop computers and portable electronics can be powered by 12 volt. Some other appliances, like printers and fax machines, may be converted to 12 volt if they have an external transformer that delivers 12 volt (check the label).

Energy-intensive appliances cannot realistically be used on a 12 volt solar system. Both because of the low voltage and because of the cost in batteries and solar panels. Examples of unrealistic uses are:

- hair dryer (except low-power versions)
- electric space heater
- electric stove
- electric water heater
- toaster oven
- electric juicer (manual models available)
- dish washer
- air conditioner (swamp cooler is okay)
- electric clothes dryer
- laser printer
- vacuum cleaner (except low-power versions)

Occasionally used items, such as a clothes dryer, washing machine, vacuum cleaner and well pump can be run with a generator. Some people have even done it with electric water heaters and air conditioners.

Otherwise, one must do without or use alternative fuels, such as propane and natural gas. There are refrigerators, freezers, stoves and even an air conditioner available that run on gas (though it probably requires 120 volt AC for the controls). Gas is problematic for people with MCS, but can be used safely (see later).

People with MCS may use a washing machine more often than other people, especially to break in new clothes. Such a need must be carefully considered. Some people are able to break in new clothes by soaking them in a barrel for many days instead (change the water every 2-3 days).

4. Households with a member who is not sensitive

If a member of the household is not sensitive, it may be a good idea to let him or her have a separate outbuilding (garage, shed, mobile home) with regular electricity. This can either be by having the grid connected just to the outbuilding, or have a separate solar system with an inverter there. It is important that there is absolutely no electrical connections to the main house. Not even a grounding wire.

If an inverter or other high-EMF device is used, this outbuilding should be at least 75 yards from the main house. If there is just regular non-wireless computer equipment, about 40 ft/13 m may be sufficient. More is always better. Such a setup could allow the non-sensitive person to use a computer, have satellite TV, fast internet, etc, alleviating a lot of stress.

5. Sources of 12 volt electricity

There are multiple ways to generate 12 volt DC electricity, including solar panels, fuel cells, wind generators and micro hydropower. It is also possible to convert from 120 volt grid power. Each of these methods have their own set of issues.

5.1 Fuel cells

Fuel cells generate smooth clean DC electricity directly and may one day become a great solution for 12 volt DC power needs.

A few fuel cell systems are available, but they include an inverter for generating AC electricity. These systems are also very expensive.

It may be possible to modify a commercially available system, or build one from individual parts, to produce pure 12 volt DC, but this is still pioneer territory.

5.2 Using grid power

Twelve volt DC can be produced from normal grid power using a transformer and rectifier. The benefit of this method is that it is lower cost, low maintenance and power is basically unlimited. It does require that grid power is available, of course.

There are multiple issues, however. It is not just a matter of buying a car battery charger and a couple of batteries, or a standard power supply. These will not produce clean DC electricity.

Incoming dirty AC electricity will carry through and produce dirty DC electricity. The charger/transformer/rectifier system itself radiates EMF and may also produce dirty electricity, if a switch-mode system is used.

This author hasn't seen a successful attempt at doing this, and only one failed attempt. A workable system would probably require:

- an iron-core transformer with full primary/secondary separation
- no switching electronics
- hefty filter/capacitors to smooth the DC
- assembly mounted minimum 40 ft/13 m from living area

Whether such a system can fully remove dirty electricity from powerline communication systems (PLC, BPL, PLT, TWACS, etc.) is uncertain. The author has not tested this setup due to cost.

Even though power is unlimited from the outside, there are still limits on the inside simply because 12 volt cannot handle large loads, such as cooking, space heating, etc.

5.3 Solar panels

Photovoltaic solar panels work by converting sunlight directly into pure DC electricity. They do not emit any dirty electricity or radiation of any kind, unless they are connected to inverters or other devices that are not needed in a 12 volt home.

Solar panels need sunlight to work, they work best in sunny climates. They can be used in cloudy climates, but then more panels are needed. Solar panels are only seasonally usable in areas with few daylight hours in the winter, such as Alaska and Scandinavia.

Living on solar requires the household to live in tune with the sun. When the batteries are fully charged on a sunny afternoon, the power from the sun is "use it or lose it", but on cloudy winter days one must very strictly conserve the energy or crank up a generator.

5.4 Wind and micro hydro systems

This author does not have direct experience with such systems and does not know any people with EHS who do.

Both types of systems generate AC electricity, which must be rectified into DC electricity. But it will not be smooth DC, it will still fluctuate and may be a problem for the sensitive person. It may be possible to smooth the ripples in the power out by using very large capacitators.

Wind generators can be extremely noisy in windy weather, especially the small simple models. Many sensitive people are bothered by this type of noise. A wind generator should be placed well away from a house, preferably hundreds of yards. This will require a higher voltage and a step-down transformer near the battery bank.

In sunny areas, such as the deserts of the United States, there is little reason to use anything other than solar power. In other areas, wind and micro hydro may be necessary to make off-grid living practical.

5.5 Generator

A generator is essential for most off-grid houses. It can power a washing machine or a well-pump to fill a holding tank, or it can be used to charge a battery bank when there is not enough solar or wind energy.

It is best not to rely on a generator for daily use, as they are costly to run, both in fuel and maintenance. Some sensitive people are affected by the noise, fumes and dirty electricity from generators. Even the best quality generator has all of these problems.

It is probably even more difficult to produce clean 12 volt electricity from a generator than it is from grid power (see earlier), due to the low quality of the generator's sine wave (this includes the models with a built-in inverter).

6. Practice off-grid living before you commit

Living off the grid is a major change in lifestyle for most people. It can be a good idea to try it out first, before committing to it. That does not need to be a major ordeal, and it can be done even in an inner-city apartment.

Perhaps buy one solar panel that can fit in a window (preferably south-facing) or sit on a porch or balcony. Add a small charge controller and an RV/marine battery, and you have a small solar system. Play with the system to get a feel for what such a small system handles, and try out 12 volt lights, etc. Measure the voltage on the battery to see how it gets filled by the sun, and how using electricity affects the voltage momentarily and over time.

Experiment with various 12 volt lights to see how they work for you. There are several types to choose from.

If you use any portable electronics, such as a computer, try to charge it using solar power. Just beware that this small system may not be able to handle the load for more than a few minutes.

At the end of this article is a link to various articles, including one on how to build such a smaller starter system.

Think about how to do various chores without regular grid power, and try them out, if possible. Can you use a clothesline to dry clothes, for instance? Perhaps buy a propane camping stove and try to cook outside (even people with severe MCS can do it).

Perhaps designate one evening a week as "off-grid night", where the breakers are turned off.

The rest of this article series covers the various alternative technologies available. They will not work for everyone, so it is best to carefully consider the changes needed before committing to them. Practicing can both make the transition easier and seem less overwhelming.

For more information

See www.eiwellspring.org/offgrid.html for the rest of this article, as well as other low-voltage off-grid articles.

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