

Safer Solar Power: Notes and Resources

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Most folks know solar power's benefits: it minimizes dependence on fossil fuels and the corporations that provide electricity. Solar photo voltaic power systems also have a rarely-discussed shadow side: their power delivery can generate extremely low frequency (ELF) and radiofrequency (RF) radiation. The World Health Organization (WHO) considers such electromagnetic radiation (EMR) Class 2B carcinogens. Long-term, chronic exposure to EMR can compromise peoples' health,

To keep energy efficient *and* healthy, we each walk a steep learning curve. This paper presents questions on systems that use DC output photo voltaic cells. It aims to encourage discussion and provide resources for reducing EMR emissions and exposure with solar power.

How do solar powered systems generate EMR?

Photo voltaic solar panels collect sunlight and convert it to direct current (DC) electricity. To provide AC electricity at outlets (since many electronic devices and appliances ultimately require alternating current (AC) electricity), the collected DC goes through an inverter. Most inverters generate magnetic fields, also called ELF/EMR (extremely low frequency/electromagnetic radiation).

An inverter's EMR emissions can exceed safety standards for workers (set by OSHA), people with medical implants (set by the FDA and implant manufacturers), and the public health (set by several European countries and the WHO). No US government agency has established safety standards for EMR exposure for children or pregnant women.

Inverters also generate "chopped" current on 60 Hz wires, distorting the expected smooth, 60-cycle sine wave. This is sometimes called "dirty" power or "dirty" electricity. Dirty power can start at powerlines or within a house. It can travel throughout a building's wires, inside and outside of the building.

Further, most devices and appliances are designed for DC. To use the AC available at standard outlets, most electronics use a switch-mode power supply (SMPS) to convert AC to DC. (This is actually energy *inefficient*.) SMPSs also generate magnetic fields.

The net meter (which tracks surplus electricity you send to the utility *and* what you draw when you have none stored) connects you to the grid. It may emit pulsed RF radiation--like a "smart" meter.

If you lease a solar system, the contract may prevent you from removing the transmitting meter.

Bill Bruno, PhD, biophysicist An inverter's manual (or that of an SMPS) may advise that if your radio or TV receives interference, move it further from your inverter. This is because even "pure sine wave" inverters use electronically switched transformers that operate at several tens of kHz, generating harmonics up to 100 MHz. Unless enclosed in metal with filters that have inductors, capacitors and ferrites (Filtron and Genisco are good quality examples) on every wire, this RF radiation will escape through the air and along house wiring. *Prevention Magazine* calls this "dirty" electricity and describes some of its associated health hazards. www.prevention.com/health/healthy-living/electromagnetic-fields-and-your-health.

What populations can be harmed by chronic EMR exposure?

Let's clarify that health problems resulting from EMR exposure are usually not noticeable *immediately*. Most diseases take years to develop.

Children are especially at risk since their skulls are thinner than adult skulls, their bodies are smaller with larger surface areas, so they therefore absorb more radiation.

People with medical implants (i.e. cardiac pacemakers, deep brain stimulators, insulin pumps) may notice immediate problems: EMR emitted by metal detectors, car battery recharging systems, transmitting utility meters and other electronics can reprogram or shut off an implant.

Many studies find that wildlife are harmed by EMR exposure.

What are common sources of EMR?

Incorrect wiring (loose connections, paired neutrals, hots and neutrals that are not closely paired), bad grounds. Powerlines, transformers, motors, SMPSs, compact fluorescent lights, dimmer switches, DECT cordless landline phones, "smart" utility meters...and solar power systems. (This paper does not cover EMR emissions from mobile devices or services.)

Regardless the power source, how do we reduce EMR exposure?

Periodically measure your home's EMR levels with magnetic field and RF meters.

Get your ground checked every few years by an electrician.

Every decade, ask your utility company to tighten its neutral wire that connects to your circuit box.

While you sleep, keep wiring in walls, alarm clocks, cordless phones and cell phones and chargers at least three feet from your head. Electronics that use more power--like air conditioners, refrigerators or utility meters, which could be on the other side of a bedroom wall--might need to be at least six feet away from your head.

"Power down" at night. Turn circuits off.

Beware that some energy-saving appliances' power supplies may put very high frequency noise and harmonics on wiring.

Avoid blenders, pool pumps and other appliances with variable speed motors. Use single-speed motors.

Some folks find that Stetzer or Greenwave filters (which have only one capacitor) improve sleep and health. Others note that they increase magnetic fields, consume power and do nothing to DC systems. Before you buy, know how to test the product's effectiveness and its return policy.

Metal roofing and/or aluminum siding can shield RF fields well. *However*, if you've got Wi-Fi, cordless phones or mobile phones operating inside a metal-cased building, your EMR exposure may intensify.

Get *wired* Internet access. Eliminate cordless DECT phones. Restore corded landline telephones. Keep mobile devices off.

Reduce your power use by reducing your use of electronics. Use solar ovens. Replace electric heating pads and blankets with hot water bottles. Beware of children (and adults) getting cuddly with electronic toys. Don't just change your power source. Change your lifestyle.

How do we create safer solar power?

Option #1: Keep the system DC

Use 12-volt batteries to charge electronics. Use a universal adapter that regulates DC voltage output and polarity to a device. This is not an AC-DC inverter. A universal adapter requires reading the operating voltage and polarity listed on the device, then setting the adapter to match. While this is easy, if done incorrectly, you can damage the device and/or adapter.

You may need to retrofit wiring, depending on the power draw of your major appliances and electronics.

Get DC-powered appliances, such as an on-demand propane, natural gas or solar water heater that uses two D-cell batteries for ignition (and no pilot light). Boat and RV dealers familiar with 12-volt-powered appliances may be especially resourceful. Use well-ventilated propane or natural gas refrigerators, stovetops and ovens.

Note that some DC-powered devices can increase or reduce EMR exposure. Factors include the device's motor type and size.

Option #2: Create a safer AC solar system

When you can, use DC applications.

Get a better quality inverter. For example, a 12 VDC motor driving a 120 VAC rotating generator can produce very clean 60 Hz power. Motor generator rotary converters commonly convert 50 to 60 Hz or 60 to 400 Hz, or even 60 to 60 Hz for isolation (dirty in, clean out--instead of big filters).

Most inverters now include a transmitter that signals that the inverter is working. Have a qualified technician disengage this transmitter.

Keep the inverter and net meter far from frequented areas, especially bedrooms. Remember, walls do not shield against EMR emissions.

Note that electricians and solar technicians usually are not trained to measure or reduce EMR emissions; and we have inadequate standards on EMR emissions. Hire a qualified EMF consultant (see resources) to:

- * Measure your home's EMR levels.
- * Get an electro-mechanical meter to track and transmit electricity sent to your utility company. Do not use a wireless meter.
- * Install a conditioner (i.e. a Tripcon) at your breaker panel.
- * Get an inline, high-grade "power cleaner."

Yaqin Sliwinski, EMF consultant, emfhelp.com: Some people think the inverter "sleeps" and does not emit magnetic fields or unintentional RFs at night. But whenever you use power, you activate the inverter (which may then emit EMR). Also, if you stop charging a device and pull its electric cord, if the charger is still plugged into the wall, it will still emit EMR.

Do inverters and net meters emit EMR at night? To find out, use audible magnetic field and RF meters to record the devices' transmissions over a 24-hour period.

Lighting

Eliminate dimmer switches and compact fluorescent bulbs, which put high frequencies and harmonics (dirty power) on wires.

Use DC/battery-powered lighting systems.

LED bulbs are cleaner than fluorescents and may have less flicker.

Use a portable AM radio tuned between stations to test for ELF/EMR emissions from lights. If it "screeches" as you approach the light, you've got EMR.

Catherine Kleiber In 1996, after graduating from college, my husband and I bought a farm. I soon developed chills, low-grade fevers and drenching night sweats. Exertion often left me feeling like I had lactic acid burning in my muscles. Washing dishes, I got lightheaded. After cooking on my electric stove, I felt too sick to eat. I had nerve pain everywhere.

After five years, my husband and I learned that we had high frequencies on our wiring, which came from fluorescent lights, electronics, variable speed frequency drives (used by heating systems, milking machines and other common appliances) on our electrical grid.

As an experiment, we turned our circuits off at night. Almost immediately, I woke feeling well rested. Many symptoms went away. A week later, I woke full of despair again. I figured that my week of feeling better was a fluke. Then, when a light switch went on, I realized that my husband had forgotten to turn off the circuits the night before.

My private "blind" study showed that electrical pollution affects my health. We got a gas stove and shut off all non-essential power. After my health improved, my husband and I had two wonderful children.

In 2009, our electric company began installing AMR transmitting utility meters in our area. Immediately, our home's RF levels increased, even though we had no transmitting meter and no near neighbors.

In 2010, our younger son began waking in the middle of the night, sweating profusely. His heartbeat would change from overly fast to slow and irregular, and finally to extremely slow and irregular. I felt lucky to know that RF signals can cause cardiac arrhythmias, including in children.

Realizing that neither our public service commission nor our utility company would mitigate the high frequency fields coming into our house on the utility wiring, and that we could lose our son, we went off-grid. We installed a gravity flow solar hot water heating system, a solar photo voltaic system and a well pump and sump pumps that operate with direct current. We got a propane refrigerator and battery-operated LED camping lights. Our computer runs off of our battery bank, and we only use it when the bank is not charging. For Internet access, we dial up. Because the washing machine requires the generator (and its use puts high frequencies on our wiring), everyone gets out of the house at laundry time. We dry our clothes on the line outside. A DC solar system has restored our family's health.

Paul Harding, EMF consultant, www.totalemfsolutions.com Identifying sources of EMR and cleaning up electrical problems is time-consuming and complex. I start by locating wiring errors and "noise" with GigaHertz Solutions meters--an NFA 1000 for ELFs and magnetic fields, and an HFE 59B for RF fields. I aim to get the fields in a building as close as possible to the Earth's electromagnetic fields, including in a solar-powered home. Once the house is cleaner electrically, I routinely see peoples' sleep improve, headaches go away, even blood sugar levels normalize.

The newest solar power systems have no batteries

Some solar systems are being installed now without batteries: 12-volt DC power collected by the panels goes directly to an inverter, which provides AC electricity to the house's 60 Hz wiring.

Since there's no battery involved, unused power has no storage place. Unused power goes to the utility company.

What are the benefits of this kind of system?

1. You reduce your carbon footprint somewhat.
2. You don't have to buy batteries; and a battery can cost more than \$1000,
3. The power you produce for the utility gives you credit for electricity that you use during the night and on cloudy days.

What are the problems with this kind of system?

1. You still depend on the grid. You're still connected to it.
2. At night or on a cloudy day, when your panels don't generate an adequate amount of electricity, you'll need power from your utility, since you have no battery-stored back-up.
3. If/when the power grid goes down, you may also have no available power, since you have no electricity stored.
4. You're exposed to EMR emitted by the inverter and the net meter that sends your unused electricity to the utility company.

Further RESOURCES

Brodeur, Paul, *Currents of Death*, Simon & Schuster, 1989. Originally published in the *New Yorker*, describes health effects of EMR exposure.

Riley, Karl, *Tracing EMFs in Building Wiring and Grounding*, 2nd ed. ELF Magnetic Surveys, 2007. www.magneticsciences.com.

Singer, Katie, *An Electronic Silent Spring* (Steiner Books, 2014)

www.electronicssilentsspring.com

www.bioinitiative.org Peer-reviewed studies about EMR and health.

www.buildingbiology.ca Includes Katharina Gustavs' 2008 paper, "Options to Minimize Non-Ionizing Electromagnetic Radiation Exposures (EMF/RF/Static Fields) in Office Environments."

"Children, Radiation and Health," by Erica Mallery-Blythe, MD,

www.youtube.com/watch?v=sNFdZVeXw7M

www.electronicssilentsspring.com/aiming-to-first-do-no-harm/ Talk by Katie Singer about electronic interference and medical implants.

www.electronicssilentsspring.com/primers/wildlife/

www.electronicssilentsspring.com/filtering/ Discussion by electrical engineer Al Hislop about filters; Canadian study about filters.

www.50hz.com/Rotary/rotary.htm Offers cleaner inverters.

www.conradbiologic.com Flicker-sensitivity and more.

www.ehtrust.org; www.babysafeproject.org

www.phliving.us/ Building healthy homes with DC power

www.saferemr.com Peer-reviewed studies about EMR and health, posted by UC/Berkeley School of Public Health.

Meters, consultants

www.emfhelp.com Consults; West Coast-based.

www.emrsafety.net Consults for schools and homes; East Coast.

www.magneticsciences.com Rents meters.

www.slt.co Sells meters, lists North American consultants.

www.totalemfsolutions.com Consults, Southwest-based.