

To read an Institute for Building Biology and Ecology (IBE) **Position Paper on Photovoltaic Electrical Systems**, click [here](#).

To read an article by building biologist, Michael Schwaebe, entitled **Mitigation of Dirty Electricity from Solar Inverters**, click [here](#).

Most people are under the impression that all EMFs are produced locally around a device or power line. That is normally the case, but when it comes to solar panels and the EMFs associated with them, that is not necessarily true.

Solar panels or photovoltaic systems have two components. The first is the panels themselves. These produce low voltage DC electricity from sunlight striking panels containing minerals that convert light to electricity. Those panels themselves do not produce any significant type of EMF that we consider to be harmful.

That electricity then travels down wires usually at 24 Volts DC to a box called an inverter that converts that electricity to a form that is usable for powering lights and appliances. That would be at 120 Volts AC. The inverter can be one or more large boxes attached to the side of the house, or they can be micro-inverters mounted underneath each panel on the roof. In the latter case, electricity at 120 Volts AC then travels in the metal conduits down from the roof to the inverter at the side of the building.

In either case, that electricity is then usable by the electric grid and its customers. You can either own your own equipment and store that electricity or sell it back to your electric utility in what is called “net metering.” These arrangements can get complicated and are beyond the scope of this article, but essentially this electricity is used directly by the homeowner, or sold back to the utility, in which case the homeowner continues to get electricity from the utility but at a fixed rate over the term of a lease, usually twenty years.

If electricity comes down from the roof on wires in metal conduits as low voltage DC to an inverter on the side of the building, there are no significant EMFs along the route of the conduit. If the electricity comes down from the roof as 120 Volt AC electricity from micro-inverters, there would still not be significant EMFs coming from the conduit. This is because a magnetic field would be avoided because the current traveling down from the micro-inverters on the hot wire in the conduit would be equal to the current flowing back up to them from the neutral wire in the conduit.

Whenever we have AC current flowing on a wire in one direction, there is a magnetic field. However, when we have the same amount of current traveling back on another wire in the

opposite direction right next to the first wire, then the magnetic field of the second wire, which circulates around the neutral wire in one direction, cancels the magnetic field around the first wire, which circulates the other way. The two criteria we follow to avoid magnetic fields in circuits are therefore met: the two wires are side by side and the current loads on each wire are equal. This is discussed in detail in my [Article on Magnetic Field EMFs](#).

There would also not be any electric field EMFs from these metal conduits because the conduit would be grounded at one end and continuous along its entire route. When that is the case, that metal sheathing contains electric fields produced by voltage on the hot conductor within it. This is discussed in more detail in my [Article on Electric Field EMFs](#).

In this way, two of the major EMFs we deal with are taken care of by the use of metal conduit containing hot and neutral wires with balanced loads. (This would only be true when 120 Volt AC electricity comes down from micro-inverters under solar panels.) Again, when the electricity coming down the wires is low voltage DC, then it does not have significant magnetic nor electric fields in the first place.

It turns out the other two types of EMFs that we deal with, radio frequency EMFs and dirty electricity, end up being the two types of EMFs that we encounter from solar panel / PV systems.

Radio frequencies come into play when you lease your panels from a company that arranges with your electric utility to “net meter.” This means your solar panels produce more electricity than you consume with that excess electricity going into the utility grid. The solar company, such as [Solar City](#) or [Verengo](#), must know on a regular basis how much electricity their panels up on your roof are producing when the sun is shining. This information is nowadays sent to the company wirelessly from a transmitter in the inverter or from a smart electric meter that the solar company installs on the side of your house. When micro-inverters are used, that transmitter is in each micro-inverter under each solar panel. All of these transmitters usually send data to a nearby cell tower at a regular interval, such as once to four times an hour.

In those parts of town where cell service is weak, some companies will install a non-transmitting electric meter that conveys its data to your router using an Ethernet cable. The information is then sent on the Internet to their home office. [Verengo](#) allows its customers to do this, using a Locus L-Gate 100 non-transmitting electric meter that uses an Ethernet cable to connect to the router indoors.

Other companies, such as [Solar City](#), use an inverter, particularly the Fronius brand, on the

side of the house that sends its data four times an hour wirelessly using Wi-Fi to a gateway wireless device inside the home. That gateway sends and receives wireless signals to and from the inverter that are then sent via an Ethernet cable directly to the homeowner's router, and from there to the solar company's home office.

Some electric utilities, such as Los Angeles Department of Water & Power (LA DWP) reportedly want to monitor the data being sent by the meter or inverter used by solar companies for themselves. DWP therefore requires its net metering customers to have a second DWP smart meter on the side of the house in addition to the solar company's smart meter to send data regularly to DWP's headquarters, using a nearby cell tower (since DWP has not yet installed smart meter neighborhood mesh networks throughout its service area). DWP will then also replace your regular house analog DWP electric meter with a smart meter that likewise transmits data to a nearby cell tower (you are not allowed to have an analog electric meter when you net meter with LA DWP if you have solar panels).

Customers of Southern California Edison, on the other hand, don't need a second smart meter. Edison reportedly trusts the data being sent to them by the solar company's meter or inverter.

Customers of San Diego Gas & Electric who net meter are likewise not required to have a second SDG&E meter, as that utility also trusts the data being sent to them by the solar company for net metering customers with solar panels. One other good thing is that SDG&E will allow you to have an analog meter and opt out of their smart meter program while net metering. If you then go with Verango and have them install their Locus L-Gate 100 non-transmitting electric meter that uses an Ethernet cable to send its data to their offices through your router, those of you in San Diego and Southern Orange County in the SDG&E service area won't have any radio frequency EMFs from your solar or electric equipment.

The biggest EMF issue with solar panels, however, is dirty electricity, also known as DE. This form of EMF is comprised of higher frequency harmonics above 60 cycles per second (Hz), the frequency of electricity on typical house wiring. In fact, the fundamental frequency of dirty electricity coming from many solar system inverters is 20,000 Hz, or 20 kiloHertz (kHz). That would then have harmonics at 40 kHz, 60 kHz, and so on. This is demonstrated on spectrum analyzer tracings I obtained on my oscilloscope from inverters at several clients' houses that you can see in my article entitled, "Spectrum Analysis and Oscilloscope Tracings of Harmonics from Photovoltaic (PV) Grid-Tied Inverters," accessed [here](#).

Dirty electricity in the case of solar panels is created in the process of converting low voltage DC electricity from the photovoltaic panels up to 120 Volt AC electricity. Some brands of

inverters are better at doing that without producing electronic “noise” than others. Apparently the Outback brand inverter is reported by others in and outside my profession to be one of the models that produces more DE than other brands, while the Sunny Boy models made in Germany produce some of the least. [Sunny Boy](#) apparently is aware of this phenomenon and is said to have designed their inverters to minimize this effect. Models sold under the [SMA](#) label are reportedly similarly low in producing DE. I am told that micro-inverters tend to be cleaner, as well.

That is not to say that the electricity coming out of a Sunny Boy or SMA inverter is completely clean. It is reported to still have some degree of dirty electricity, but compared to other companies, it is the least. You have to decide if this will be a health problem for you or not.

In fact, dirty electricity is the hardest form of EMF to measure and mitigate. It is caused by many sources these days, including dimmer switches, variable speed energy-saving motors in furnaces and front load washing machines, many electronic devices from computers to printers, and most famously from chip-based switched mode power supply transformers in such energy saving devices as compact fluorescent lamps (CFLs), LEDs and halogen fixtures (halogen incandescents run directly off 120 Volts and don't have switched mode power supplies. They therefore don't have dirty electricity—see [Healthy Lighting Choices](#).).

Dirty electricity is indeed emitted from the device that produces it into the surrounding air, such as dimmer switches and solar panel inverters. However, most of the dirty electricity these sources produce travels on electric circuits throughout the house riding on the 60 Hz sine wave of conventional electricity, both downstream and upstream from the source. DE can then hop from circuit to circuit, and even travel back to the neighborhood electric utility transformer and pass from one house to another.

Thus, dirty electricity from your solar panel inverter can and will travel throughout your house, emanating off wires in walls and electric cords you plug into outlets, even when lights and appliances are turned off. This field of dirty electricity EMFs enters rooms in your living space up to six feet from circuits in walls and from power cords and bothers many electrically-sensitive people.

I have electrically-sensitive clients who call me up and say they moved into a house with solar panels or had them put on their house, and now they cannot be in the house when the solar panels are running. Plugging in [Stetzer](#) and other resistive/capacitor dirty electricity-reducing filters does not always help. Nor do the whole house dirty electricity-reducing devices sold by [Satic](#) nor by the [Rx-DNA](#) system in every case. On the other hand, there are some electrically-sensitive clients who have been able to use RxDNA and Satic systems with

their solar panels with success. It all depends upon the person and their degree of sensitivity.

My advice to my electrically sensitive clients is that if they don't already have solar panels and are thinking of installing them, they should reconsider and decide not to do so. I have seen too many people make that decision and then regret it. You can't easily take a system out once it is installed, especially if you have signed a twenty year lease

In my opinion, if you are electrically sensitive, don't take a chance with your health. Avoid solar panels altogether to prevent possibly reacting to them once installed. Save energy and electricity bills other ways.

If, on the other hand, you are not that electrically sensitive and want to have solar panels, then don't enter a lease with a company where you don't have control over the brand of inverter they will use. You also want to avoid being locked into equipment that has to send out a wireless signal several times an hour to connect with the home office.

If you choose to own your own equipment, on the other hand, purchase an inverter from Sunny Boy or SMA and get a whole house Rx-DNA or Satic system.

If you do want to lease, go with Verengo and have them use micro-inverters and an L-Gate 100 electric meter. (If you are in the Southern California Edison service area, however, you will have a radio-frequency transmitting smart meter from Edison and cannot opt out of that program.) Then get a whole house Rx-DNA or Satic dirty electric-reduction system which is a good idea in any event to reduce dirty electricity from dimmer switches you may choose to use as well as to condition dirty electricity possibly coming in from your neighbors.

You can order the Rx-DNA system from Michael Schwaebe, a Professional Engineer and building biologist in Encinitas, located in North County San Diego. Michael is a nationwide distributor. Contact him at 760-753-7752 and mjschwaebe@gmail.com.

You can order the Satic system from William Holland of [Holland Electrical EMF](#), an electrical contractor in Topanga, California outside Los Angeles who has also taken building biology training and does EMF consulting. Contact William at 818-292-1271 and wm.hollandelectrical@gmail.com.

Then be aware that after all these precautions, you are taking a chance that you still could react to the dirty electricity that will still be there to some extent, even if it is filtered with an Rx-DNA or Satic system.

Finally, solar panels themselves don't emit much in the way of EMFs from their location on

your roof, especially at night when the sun is not shining. Therefore, they can be placed on the roof above your bedroom. However, bear in mind that certain electrically sensitive people do report that they are still bothered by solar panels on the roof above their bedrooms even at night when they are not operating. I tell these clients of mine who are that sensitive that they really are well advised to not put solar panels on their house or purchase a home that has them in the first place.

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[Oram Miller](#)

BBEC, EMRS, Certified Building Biology™ Environmental Consultant and Electromagnetic Radiation Specialist and Healthy New Building and Remodeling Consultant. Providing On-Site EMF Evaluations for Existing and New Homes and Offices in Los Angeles, Orange, Ventura, Riverside and San Diego Counties and Nationwide by Telephone and Skype. Based upon the principles of Building Biology™.