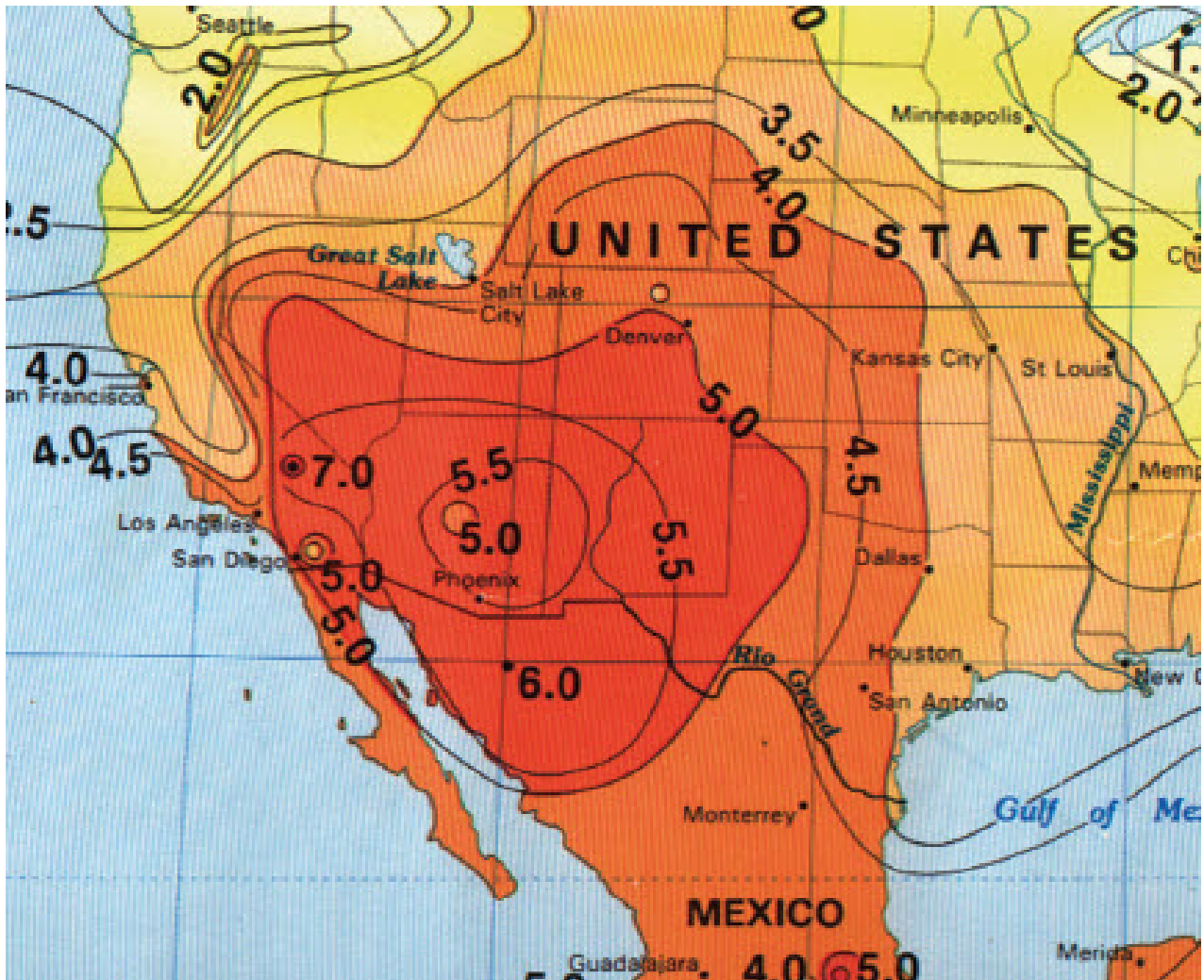


Live Safer with Solar

Using Solar Energy for
Emergency Preparedness,
Disaster Mitigation,
Disaster Recovery and
Safer Living



Solar Insolation (Radiation) Map

A Solar Living and Preparedness Handbook

A Note on Using Solar for Emergencies

In the year before Hurricane Katrina, Florida was hit by 4 hurricanes. Power outages throughout the state were widespread. Numerous Floridians turned to gas powered generators to keep their refrigerators and lights operating. Sadly, many negative results occurred as a consequence.

During this period of widespread power outages I received many emails and phone calls to inform me of the various troubles of the people living with no grid power. This sad information came my way because of a blog that I have been keeping for over 6 years called "Solar for Emergencies" (solarguy.blogspot.com). I was told that my scant information about the safe use of solar during and after power outages could be life-saving to many families. Some of the situations residents reported were:

- * Gas generators were being run almost constantly at most residences that were not destroyed or badly damaged by hurricane winds.
- * Noise and fumes from the gas operated generators were everywhere causing nausea and sleepless nights.
- * Thousands of generators were being stolen by thieves, some taken while still running.
- * To stop theft, a few people ran their generator in locked garages with a box fan in the garage window thinking it would exhaust dangerous fumes, often with deadly consequences. I was told that entire families were killed by carbon monoxide entering the house while the family slept.
- * Generators, after running for several hours, were refueled while the generator was blistering hot. Unfortunately for many, the flammable gasoline was spilled resulting in a disastrous situation when an uncontrollable fire caused destruction of homes and lives.
- * Florida locals were dealing with the resultant tragedies with little or no national press coverage of the true dangers of gas/diesel driven generators.
- * Fuel to operate the generators was often hard to find or drastically overpriced when available.

Years earlier I had learned from a survivor of Hurricane Andrew that the above negative conditions were the norm during extended regional power outages. In 1999 a fellow that came into our store related to me that after Hurricane Andrew he and his brother lived precariously for several months without power using a gas generator for electricity. He told me that he or his brother had to stay up 24 hours a day guarding the large generator that they had, even when silently locked up in the garage. He recounted that life consisted of keeping a loaded shotgun within reach with the generator in view through his open kitchen/garage door. He told me that "this was no way to live" and that "if ever faced with a similar emergency" he "would never use a noisy attention getting generator to provide power".

Because I had been in the solar industry for almost 20 years I knew that there was a safer way. I started a blog titled "Solar for Emergencies" with various posts about using different solar devices that would provide a safer environment for families and individuals before, during and after an emergency or regional disaster.



A few years later, after receiving emails and phone calls from the Florida folks, I started a personal web site titled the same as the blog providing more information and links to help people realize the tremendous value and safety of solar. During this time, earthtoys.com asked me to write a series of articles that addressed multiple ways solar could alleviate stress and inherent problems during and after emergencies or disasters. Though a little outdated, the six articles are still valuable and published on their website. The articles are linked through my Solar for Emergencies site (solarprepared.com) or the Vegas Trailer Supply website (vegatrailer.com).

The articles are titled: 'Safer Lighting with Solar', 'Safer Cooking with Solar', 'Safer Water with Solar', 'Heating, Cooling and Refrigeration', 'Safer Back-up Power with Solar' and 'Live Safer (and Better) with Solar'. In this publication these six articles are presented along with related topics. In future releases of this booklet we will include various products with manufacture stats, most of which we have in stock at Vegas Trailer Supply.

This is not the final word, but it is my desire that it gives you another perspective to help keep your family safer in today's world.

There are many ways that solar products can be used on a daily basis and for emergencies to keep families safer. Perhaps the most important products include; SunDanzer refrigerators, low voltage solar panels to charge batteries and the popular Global Sun Oven.

Often the information and products depicted in this booklet needs updating or additions. I intend on releasing this information and make changes to the booklet as time permits. Please excuse any misspellings or grammatical errors as I believe that getting the information to families and individuals who can use it is more important than the time proofreading or rehashing would consume.

This booklet is labeled as a preparedness handbook, but it is not a complete guide. There are others who provide more comprehensive guides to emergency preparedness, but you probably won't find most of the information in this booklet under one cover in any other publication. It is meant to be an addition to your library, hopefully an important addition.



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Please note that this is a draft version of a larger publication of the same title due to be released in the future. This booklet is pre-released to get this information to people in a timely manner because of the current negative economy.

This version has been adjusted to fit a loose leaf binder. Future versions may not be in this format but will include more pages of detailed solar product information, charts, diagrams, plans, glossary and related items.

Most items mentioned in this booklet can be found at Vegas Trailer Supply or can be special ordered.

There may be mistakes and misspellings. I would be grateful if you would bring any you see to my attention.

Let's keep in touch!

Michael

Types of small solar systems:

The smallest solar systems are simply a "battery maintainer" that keeps a battery from losing its charge. Large systems include larger solar photovoltaic (PV) panels that will re-charge a battery after it has been used (put under a load). The larger and more expensive the panel, and other components, the more power you have to use. Systems needing to run typical household appliances can cost tens of thousands of dollars. Smaller emergency backup systems to run a light or a small TV can be very inexpensive.

PV panels have a positive and a negative connection, just like a battery. The two wires are hooked to a controller, which stops the battery from overcharging, and then hooked to the deep cycle battery. The positive wire must have a fuse in the line. This fuse protects the circuit (wire) from any shorts or pulling too much current which could melt and burn the wires.

Multiple panels and multiple batteries can be hooked together. Proper wire sizes and controller sizes must be used. Larger systems need a code approved disconnect switch installed.

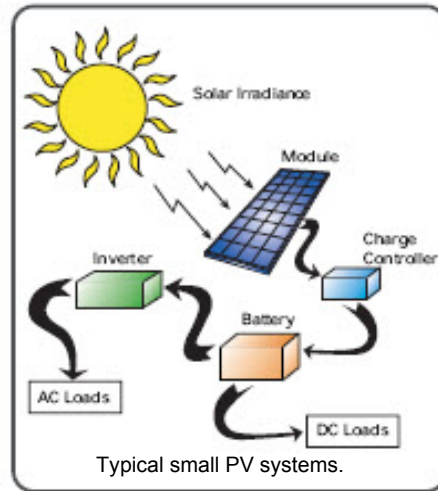
An inverter is a device that turns 12 volts DC into 120 volts AC current. Household appliances are 120 VAC. Inverters come in large and small sizes. Proper attention should be made when sizing and installing an inverter. Small inverters can plug into a 12 volt cigarette lighter but often the wire size in the lighter plug is too small.

When considering a portable solar system for emergencies, attention must be made that the panel is well supported, the battery is in a vented container and all connections are proper. I like to use a small insulated ice chest to put the battery in. This can be vented, wired and a 12 receptacle installed very easily. The cooler provides protection of the battery so that the sun doesn't hit the battery directly. It also stops the accidental dropping of a metal tool on the battery terminals which could produce a fire or explosion.

Small backyard systems can be installed safely that can be used as lighting for an outside kitchen or landscape lighting then used as an emergency system if needed. Larger systems that are attached to your house or are grid connected require a solar electrician to design and install.

Panels can be installed on poles or ground mount racks, and should have a lightning arrester in the line. Roof mount racks must be designed and installed by professionals.

Controllers come in different sizes, according to the amount of current being produced by the panels. The typical RV or cabin uses more expensive wall mount controllers that have digital monitors built in.



This maintainer will keep 2 deep cycle batteries from losing their charge or run one small light for about an hour a day. A larger panel will run a small SunDancer refrigerator and provide about 2 hours of light a night. Adding more panels will produce more power.



Pole Mount & Ground Rack



Lightning Arrester



Controllers



Controllers can be small or large, in-line or panel mount with digital meter.



12VDC Accessories

12 volt accessories include extension cords, outlet receptacles, "Y" pigtails, etc. These devices can not be used with high power appliances.



Inverters: 12VDC to 120VAC

Inverters can be small or large with a wide variety of features. To save battery power try to use the smallest inverter that will do the job. Most installations require a post mount disaster fuse.



Portable Power Units

Self contained units are available that will accept multiple charge sources, including solar and provide limited amounts of 12 volt and 120 volt power for emergencies.

Safer Lighting with Solar

With the many natural disasters and recent threats of terrorism, many people are looking for ways to make their families safer in case of emergencies. There are many ways that solar energy can help families get better prepared and achieve a more independent lifestyle. Adequate backup lighting is seldom considered for emergency preparedness, but it can play a key role in easing stress if a power outage occurs during an emergency.



For years the American Red Cross has suggested that all families have an emergency plan that includes food and water storage, first aid kits, supplies, clothing, a backup cooking method, and a 72 hour "mobility bag" in case an evacuation is necessary. They never mention "solar systems" in their brochures, but I believe that solar energy can help any family, on any budget, be safer in the event that there is a power failure or similar emergency. Even a little bit of solar equipment can help families that do not anticipate "getting off the grid" by utilizing a large solar array. In fact, during a black-out a smaller system may be preferable to a larger one.

The value of a light bulb.

Soon after my family moved to Las Vegas I picked up our local newspaper and read about a family that fell on hard times after arriving in town to "make their fortune". The couple had three children and, for one reason or another, became homeless. A Good Samaritan offered their spare camper as a temporary home for this family until the husband could land a job. An extension cord was run two or three hundred feet to supply power for one 60 watt light bulb. At this distance, the 16 gauge power cord couldn't supply enough power to run anything else.

The mother and wife said that this one light bulb helped keep her sanity during the two or three months they lived in the camper. At night she had enough light to take care of the bare essentials needed for the family. She could prepare and clean up dinner, take care of minor child emergencies, and accomplish many other family duties. The kids had enough light to play, go to the bathroom, or read a book during these weeks of inconvenience.

In my preparedness and solar energy seminars I tell this story, because a little bit of safe light can make all the difference between an inconvenience and a disaster for a family.

Most people in developed countries are blessed with constant power on demand and haven't put any thought into what they would do if the power went out for an extended period of time. Their only emergency lighting consists of battery eating flashlights or dangerous oil lamps. We take for granted our uninterrupted electric supply that is completely unavailable to two billion families on our planet.

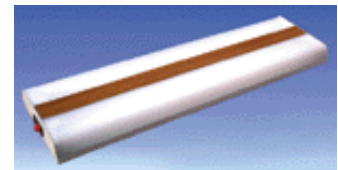
The answer to the power backup problem for many homeowners is the noisy and polluting gas generator. Back before Y2K, hundreds of people came to my store seeking advice on which generator I recommended for their family in case of a regional power failure. To their surprise I almost always said "none of them", then I related a story a customer told me.

Hurricane Andrew teaches us about generators.

This particular customer and his brother felt the destructing force of Hurricane Andrew in Florida a few years ago. His house was damaged, but not destroyed and they were without power for several months. They powered up their large generator for household use and found that it attracted unwanted attention. They had to stand guard 24 hours a day with a loaded weapon near their generator, whether it was running or not, just to keep it from being stolen. Some of his neighbors had generators taken while they were running. He then said that if faced with another power failure he would NEVER use an attention getting generator for power.

Those who have quiet solar systems with back-up batteries don't have to worry about emergency lighting, but what about the rest of us? When we think of solar systems, we think of tens of thousands of dollars. Many do cost this much but having a small effective renewable light source doesn't need to be expensive.

One single 12 VDC fluorescent light is enough light to do necessary tasks at night. The light given off is not what we are used to, but the iris in our eyes opens up and after a few minutes we find that this small amount of light is adequate.



It is much safer to use this type of soft general lighting rather than dangerous candles, oil lamps, kerosene lanterns, propane or "white gas" camp lanterns. The American Red Cross strongly advises that all flame light sources be avoided during black-outs. Earthquakes, winter storms, powerful winds or other calamities resulting in power loss usually are accompanied by fallen objects on the floor of the house that can be tripped over and a resulting fire started. They also cite thousands of home fires during emergencies because candles are left burning unattended or when people fall asleep.

If you are concerned about drawing attention to yourself during a disaster, consider that most light sources are a "point" of light. By that I mean that the light source has a high intensity point. An incandescent light bulb or flame light source has a point of light that can be seen for miles at night. A safer backup light would be a small low voltage fluorescent light that does not draw near the attention because the light is deflected over a wide area. For more privacy and security, the window curtains can be drawn and no one can tell that you have lighting in

your house. During an extended blackout there is danger in being the only one on the block with your house all lit up. It is unfortunate, but predator types will see your lights and will know that you are prepared more than your neighbor. You then become a prime target for robbery of food, supplies, or worse.

Low voltage emergency lighting.

In my new home I am installing a few thin florescent lights in strategic areas to save a little energy and have basic lighting in case of a blackout. A few years ago our family was called out of town on a family emergency and we had three hours to eat, take showers, get dressed and pack our suitcases. Normally this wouldn't be a problem, but as you probably guessed, our section of town had a blackout just as we got the phone call. You can probably see it now: Five people all scurrying around the house with flashlights and candles in hand, bumping in to each other and walls, tripping over things on the floor, real pandemonium. It would have been much safer to have low power lighting placed in key locations like the hallway, bathroom, kitchen, garage and bedrooms.

Low voltage (12 VDC) lights come in many different sizes and wattages. Solar energy suppliers have a few of these lights but if you have an RV parts store near, you might find a wider selection. You may want to pick up other 12 volt items, like a receptacle cord with battery clips, or an extension cord, etc. For a small back-up low voltage system, you will need a 12 volt deep cycle battery, a battery box, lights and a way to charge the battery.

If you plan on having one light operating for just two hours a night then a small 5 watt solar panel will do.

If you feel you will have more lighting requirements then larger panels should be considered. Do-it-yourself, plug-in solar panels come in different sizes and make installation for the novice much quicker, but often they are low power or low quality. Larger panels with more power require a controller to keep the battery bank from overcharging.

Be careful when working with batteries. Make sure that you learn the proper way to maintain, install, and test batteries. We will give you some tips and alert you to hazards about deep cycle batteries in another chapter.



Many small solar devices are available that charge up flashlight batteries, cell phones, computer batteries, etc. Some charge AA and AAA batteries, some have a 110 volt adapter or a 12 volt cigarette lighter plug receptacle. With the advent of cell phones, GPS and many

other small electronics devices there have been many solar products invented to charge these things. There are even backpacks with built in solar panels and many sizes of fold up panels for the person on the go.

Something that gets constant use is my 12 volt rechargeable 2 million candlepower spotlight. It lights up the whole back yard, or the back of my entertainment center, in an instant. Most of these spotlights use 12 volts to recharge, so they work great with a small solar system. Other types of rechargeable camping and RV lights are available. Check to see if they use 12 VDC before you purchase them. Most come with a cigarette lighter type plug attachment for DC charging.



For emergencies there are all sorts of hand crank lights, solar flashlights, and low power LED flashlights. I am sure you've seen the "shake-up" flashlight that uses a shaking motion of the hand to produce the needed power without the need for batteries. Most of these gadgets are priced high yet they use little or no battery power. I've used a small solar charged flashlight/radio regularly for years without ever putting in batteries.

By the way, the future is bright for the new high-tech, low powered LED lights. These little bulbs require a fraction of the power to produce the same lumens of light as other bulbs. They are expensive, but they last for decades. Because they require so little battery power, many efforts are being made to get LED lighting in remote villages in third world countries.

Cheap bulb trick.

If you don't want to go out and buy the latest gadget for backup lighting, I've found a neat trick: Take a regular 120VAC light fixture and replace the AC bulb with a 12 volt bulb, then hook the light to a 12 volt battery. I've done this with work lights, clamp lights, and even hanging chandeliers. Don't forget to change the bulbs if you ever hook the light back up to AC! There are many types of 12VDC bulbs available and they draw considerable power so you will want to size your system accordingly. Energy saving 12 volt DC compact florescent bulbs are available, but they cost five times more than their 120 volt cousins.



For power outages many people have purchased a portable battery pack that is pre-wired with 12 volt receptacles. Some models include DC to AC inverters so you can operate small 110VAC equipment. These compact power centers are expensive, but you don't have to build the system on your own. This option usually costs more, but well worth

the investment for someone who doesn't want to "do-it-themselves".



Larger solar systems include PV panels, mounting racks, wiring, disconnects, fusing, controllers, inverters, etc. In addition to running lights, larger systems will run other appliances such as TV's, computers, low wattage refrigerators, or communication radios.

Make sure that you seek experienced, professional advice and follow all electrical codes when putting together a system. All systems attached to your house require qualified electricians to install and hook up.

Solar panels can draw attention.

When deciding where to locate solar panels, keep in mind that they draw attention. We always recommend that they be installed flat on the roof of an RV because tilting racks for RV's are bothersome, expensive and raised panels draw attention. When an RV owner needs more power we usually recommend another solar panel. Wind generators are hard to keep hidden, but they are usually positioned on high towers, so most wanna-be thieves leave them alone.



There are many other ways that solar energy can help your family get better prepared for emergencies and achieve a more independent lifestyle. In future articles we will discuss the importance of solar cookers, solar distillers, low power refrigerators, and other solar products. If you are concerned about emergency and back-up lighting, start now to learn about all of the options. Your search will find many ways that solar energy can help your family stay safer during emergency power outages.



Be careful with batteries

Well, a picture says a thousand words. The picture on the left is a battery that was part of a system on a horse trailer that we replaced. We don't know what started the fire, but we think it was loose terminals. The owner is darn lucky his 6 golf-cart battery bank didn't blow up in his face. This battery caught fire, which the owner put out with a fire extinguisher.

Please respect batteries and follow all recommendations and safety precautions from the manufacture's and other professionals, including keeping the terminals clean.

LED'S



Over the last few years we have not been too impressed with the performance of LED bulbs (lamps) for general lighting but some recent changes are promising. We know that when it comes to these ultra-energy saving LED light bulbs technology will soon catch up with our expectations but you may want to check them out now.

Recently one of our employees (Tony) at Vegas Trailer Supply has been testing some of the new 12v LED lights for his motor home and he's found one that has the best lighting we've seen. LED lamps are bright when you look directly at them, like street lights and tail lights on vehicles or displays in a Vegas casino, but they have been lacking when it comes to general room lighting. The "white" lights have been a pale blue or purple and the cheaper red, blue or amber bulbs are ok for mood lights but you don't want them for general lighting.

We always hear that LED bulbs will last for thousands of hours or days, but they don't tell you that the resistors or the electronic circuit boards that accompany most brighter LED bulbs will burn up after a few hundred hours. One new type seems promising. No we don't sell them. We gave up trying. They were too expensive after we put a mark-up on them and the technology kept changing too fast.

You can find them at the web site where Tony buys them. Heck, we tell anyone who comes in the store to check out <http://www.superbrightleds.com> even though we don't make a dime commission. The new style Tony likes is a wafer type bulb that he can plug into a regular 1141 socket. 1141 bulbs are the most popular bulb for RV 12 volt lights and these new LED's will save a bundle of energy compared to an 1141 bulb! This bulb actually has small wires attached to the plug so that you can direct the light downward. You can actually place the wafer-like LED's directly on the plastic light lens because the bulbs produce no heat like typical incandescent bulbs.

Search around until you find it, and you will probably find a bunch more LED bulbs that you will want. I got my eye on several types for my small solar system. Heck, they only charge \$5 bucks shipping no matter how small or large the order. Tony says that he gets them in four or five days every time he places an order.

The model Tony likes is "1156-PCB-WHP9 White LED Lamp" and it is found by navigating to the "other LED Bulbs" then the RV/Marine & other bulb link. If you try some of the other types, drop us a note and let us know how you fare.



Safer Cooking with Solar

Recent threats of terrorism has put our country on a high state of alert. The Federal Emergency Management Agency (FEMA) has been working with The American Red Cross, The Department of Homeland Defense, local police departments and other agencies to educate American citizens on the importance of preparing for emergencies. Mandatory reading for every family should be an important document recently published by FEMA titled "Are you ready" located at <http://www.ready.gov>. It includes information on steps that you can take before and after most natural or man-made disasters.

Nowhere in this important publication does it mention how we can use solar energy to be better prepared. There are several products that use the sun's rays which can be of tremendous value to us before, during and after a disaster. In our first article we discussed how the sun can provide us a source of energy for "safer lighting during emergencies". This second installment addresses the importance of having backup methods for cooking food, and how solar thermal energy can, and should, top our list.

San Fernando Earthquake

A few years ago I remember watching on television how people who were directly effected by the San Fernando Earthquake lined up for blocks to get food cooked by the National Guard. People who had no food storage or a means to cook food had to wait in long lines for several hours for breakfast, wait more hours for lunch, then turn around and wait three or more hours for dinner. Thousands of people were afraid to go into their damaged houses to prepare food, so they camped in their yards for days or weeks until the threat of dangerous aftershocks subsided. Those families who had no food or a way to cook it, soon realized that eating to stay alive was a major task rather than an inconvenient "camping experience".

There are a lot of ways to cook food in an emergency. The important thing is that you make a plan, then take action, so that if needed you don't have to stand in line nine hours a day at government run food kitchens.

Black Pot Cooking

After an adequate food and water storage program, I think that one of the most important utensils you can own and use is a good quality Dutch oven.

Cooking in a black pot, like our ancestors, is fun and the food tastes great. If you are new to Dutch ovens, ask around, anyone who has cooked a few pineapple upside down cakes or home-brewed chili recipes will be glad to tell you how to do it. There are a lot of brands sold and most of them are imported, but every experienced Dutch oven cook that I have spoken to said the best pot you can own is a



"Lodge". These heavy-duty cast iron utensils are made in America by Lodge Manufacturing and will last a lifetime - or more. Investing in high quality cooking utensils will increase your outdoor cooking pleasure and insure that you have effective emergency cooking pots if needed.

Dutch ovens are easy to use, and they clean up with little or no water, (great when water is scarce during disasters). They are most often used with charcoal briquettes on the ground or on a metal table. They can be used on a propane stovetop, camp-stove, in a BBQ, or the way I like it, in a solar cooker.

To the novice, the hardest part about starting out with Dutch ovens, is the curing process. All cast ironware must be properly cured. This involves washing the unit, then baking an oil coating on it before use. Cast iron cookware can be cured in your oven, a BBQ, or almost magically in a Sun Oven.

There are several things to consider when anticipating cooking needs during an emergency:

- Type of cooking device
- what fuel to store
- what are the dangers in storing back-up fuel
- portability
- ease of use.

Risks of Fossil Fuels

Camp stoves use a variety of fuels; white gas, propane, alcohol, or unleaded gasoline. All fuels must be stored and come with inherent risks during storage. Camp stoves are portable but must be watched constantly while cooking and for a few minutes after use because of hot surfaces. The unfamiliarity of using a portable stove instead of your home stove during a stressful situation suggests a higher risk of injury, especially to small hands. Refueling stoves can lead to fuel spills and fuel can not be stored for long periods without special additives. Heavy duty propane camp stoves are probably safer and easier to use but they are heavy and less portable.

Briquettes and Fuels Produce Smoke

Briquettes are easier and safer to store for emergencies, but they are not environmentally friendly. It takes 7 pounds of wood to make one pound of charcoal. Briquettes and other fossil fuels produce smoke and advertises to the entire neighborhood that you are cooking.

If you like using charcoal briquettes, the Volcano cook-stove uses one third of the normal amount of charcoal.

The air flow is regulated and the heat is channeled to the sides of the pot so Dutch ovens work great. The Volcano

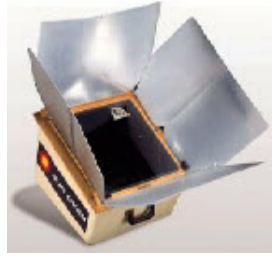
is easy to use, relatively safe and can be used with a grill for barbecuing or a pan for frying. I keep a few briquettes handy in case they are needed for cloudy



days or night-time use, but I prefer helping the trees a little by using my solar cooker on sunny days.

Cooking with the Sun

I use my Global Sun Oven to cook anything that I would normally cook in my regular oven. My family loves fresh-ground wheat bread and we regularly cook roasts, cookies, rice, casseroles, baked potatoes, cakes and more. I can't tell you how many times I've been told that sun cooked chicken tastes better than Kenny Rogers' rotisserie chicken (and I love K.R. chicken). Moisture stays in the food so it naturally tastes better. The food heats up evenly and never burns or sticks to the pan. My Sun Oven frequently reaches temperatures over 400 degrees F.



Moving from novelty to necessity, solar cooking is gaining acceptance throughout sunny areas of the world and they come in a variety of configurations. There are simple home-made cardboard and wood versions up to more expensive and effective cookers like the Global Sun Oven. There's even a mammoth commercial solar cooker called the Villager. It is easily transported on a small utility trailer and will cook up to 1200 meals a day.

Typical solar box cookers can be made easily and inexpensively, and they work. There are hundreds of sites on the web extolling the virtues of solar box cookers. My favorite site is sponsored by Solar Cookers International (SCI). In addition to providing information on solar cooking, they manufacture and sell a small cardboard solar cooker called the CookKit. They also sell books and an inexpensive device called the WAPI, which is an effective water purification indicator. SCI helps distribute



the much needed CookKit to refugee camps in Africa and other places in the world where the need is great because fuel is scarce or nonexistent. Literally half of the world cooks with fuel-wood and could significantly benefit from solar cooking.

We could entertain an entire discussion on the benefits of solar cooking, but for now I want to give you some of my thoughts on why I think that it is important to use a Sun Oven for emergencies.

Along with water and food storage, medical supplies, clothing, bedding and quality cooking pots, a Sun Oven could be one of the most useful preparedness items for emergencies. Food cooked in a Sun Oven takes about 15 to 20 minutes longer than in your regular oven. On a sunny day, bread takes

about 50 minutes and a chicken is perfect in 1 ½ to 2 hours. Normal bread pans can be used but darker colored pots are better than stainless steel or aluminum pots because they absorb the solar thermal heat better.



Sun Ovens are Portable

Often, during emergencies, families have to move quickly. Recently we have heard that families should put together a "72 hour kit" or "mobility bag" in case an evacuation is necessary. Though most foods in a 72 Hour kit wouldn't need cooking, if one had to leave for an extended period of time, the Sun Oven would be a welcome companion. Weighing in at 21 pounds it is very portable, carries like a suitcase, and other items like paper towels or light bedding could be carried in the unit.



Sun Ovens Cook Without Dangerous Fuels

An uncontrolled fire can turn an emergency into a disaster. A Sun Oven uses no fire to cook food so there is no chance of accidental fire. Due to their small burner grates, gasoline or propane camp stoves can be cumbersome to use in emergencies making it is easier to get burned from falling pots. Cooking fires must be tended to constantly. During stressful emergency situations the cook can easily get distracted, creating an increased burn risk to the wandering hands of a small child or an inadvertent nudge by a large adult. Using the Sun Oven for cooking food gives greater peace of mind than using fire or briquettes and there is no danger of spilling volatile fuels during refueling.

Cooking Fuels do Not Have to be Stored

Families concerned about preparedness will have greater peace of mind if dangerous fuels do not have to be stored in their homes or garages. We've all heard stories about disastrous home fires resulting from stored fuel. Local fire departments will be happy to learn about your new safer cooking device.

Sun Ovens are Safe to Use

While the inside of the oven chamber will get very hot, the closed and latched glass lid will not burn the skin when casually touched. Because air is moving over the top of the glass, it only reaches temperatures of about 140 degrees F. The four shiny reflectors do not get hot because they reflect most of the thermal sunlight energy into the oven.



Sun Ovens Don't Advertise that You are Cooking

Smoke from cooking fires, barbecues and stoves can travel great distances and advertise to anyone,

including the bad guys, that you are cooking food. Often in emergencies predators seek out people who are prepared. They somehow feel others owe them supplies or food, often at great cost to their victims. Though most people work together when disaster strikes, many have learned through sad experience that there are those who feel they can take what they want from others who have prepared! Solar cookers produce no smoke because fossil fuel is not used, insuring a safe and private method of cooking.

When cooking in a normal oven, that wonderful smell picked up by our noses is actually moisture molecules from the food that is released into the air. The typical oven burner is constantly replacing air in the cooking chamber so moisture is pulled from the food and released into the air. Cooking with sunlight produces very little smell during the cooking process because moisture is retained in the food.

For added privacy try this: When your food is finished cooking, simply fold up the reflectors and take the Sun Oven into the house with the food still in the oven. When you are ready to eat, simply unfold the reflectors and take out the piping hot food. This keeps the aroma of cooked food in the house. The box is well insulated and with the reflectors down I have kept dishes tongue-burning hot for over an hour.

No Stirring - Won't Stick - Won't Burn

Because moisture is retained and food heats evenly, stirring is not needed and food will not dry out so it is less likely to burn and stick to the pan. This saves food waste and clean up is easier needing little or no water. There is enough stress during emergency situations and now cooking doesn't have to be one of those difficult tasks.

We have learned from areas of the world where water is polluted with deadly bacteria that solar cookers can also be used to pasteurize drinking water. A quart of water is purified in about an hour, and in a pinch, the higher temperatures produced by commercial units like the Global Sun Oven and the Villager can sterilize medical instruments.



A Global Sun Oven will work fine on sunny winter days but they won't work at night and on cloudy days, therefore some thought should go into other back-up cooking plans. Though not essential, it would be good to become familiar

with the ease of solar cooking before it is needed in an emergency.

The large Villager Sun Oven was made primarily for remote village use, but it is a practical option for large groups or community preparedness contingency



plans. It will consistently cook food for up to 600 people without the use of any fossil fuels.

I believe that any emergency preparedness items you purchase should also help your family during non-emergency times. Solar cookers, especially the Global Sun Oven, can be an important part of your daily life and help your family attain a more independent lifestyle. I could never fully express the personal satisfaction I feel when I see loaves of bread browning to perfection without using utility energy. I also feel good knowing, if needed, my family has a safe and effective emergency cooking device powered by earth's star.



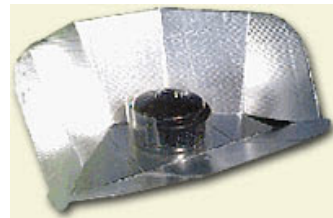
Many Styles of Solar Cookers



You can make one!

There are many styles of solar cookers, and they all work. You can find plans to build one or you can buy a commercial one that will reach higher temperatures (the Global Sun Oven). Visit vegastrailer.com or solarprepared.com for links to sites with plans for home-made solar cookers.

The least expensive and quickest to build is the CookKit style cardboard cooker pasted with aluminum foil. You will need an appropriate pan (dark, thin walled with lid) and a large turkey "Cookin Bag" that you can buy from any grocery store at holiday time. You will also need a clothespin or other bag closer to keep the heat in the bag. The pan goes in the bag and the bag sits in the center of the cardboard cooker.



It will take longer to cook in this small cooker than it takes in a Global Sun Oven. The temperatures won't get as hot but they will reach safe cooking temperatures, about 250 degrees F. Stews, casseroles and beans that have been soaked over night can be cooked. Bread can even be cooked and is often done in a coffee can. Rice is common and almost any other type of food can be cooked with a little practice. A quart of water can be pasteurized in about an hour. Figure one meal a day with this type.



Solar Cooking at a Glance

Imagine baking any food with no energy costs. Imagine baking in summer months without heating up the kitchen or house. Imagine baking food that tastes better than almost any form of cooking. You've imagined a whole new way of cooking ...With Sunshine!

Fun and Practical

Bake wonderful bread, cook delicious roasts or cook perfect rice every time. Food cooked with a Sun Oven stays moist, and the additional juices make the food taste better. It is almost impossible to burn food (except cookies) in a Sun Oven.



Cook in Your Back Yard

Food does not have to be watched when cooking with a Sun Oven, even if you accidentally leave it in the oven hours longer than usual. Because the moisture stays in the food, it comes out perfect every time. Your family will think you have discovered a new way to make food taste better than ever before. You will be amazed at how simple and easy cooking in the sun can be. You will smile at the dinner table, knowing you didn't use a drop of utility energy!



Villager Sun Oven

The world's largest commercial solar cooker will cook 50 loaves of bread at one time, providing hundreds of loaves of bread and other pastries each day for villages that have fuel shortages, or the fuel is intermittent or expensive. 12 to 15 women benefit from good paying jobs in the village bakery using the Villager.



There are 200 of these giant cookers in third world countries helping small villages maintain a bakery. Most Villagers are donated by groups and clubs. One Villager can save 364,000 lbs of wood a year. The Villager and other solar cookers can make a huge difference in forest habitat and the health of villages near by. You can help sponsor these life-saving solar ovens in many areas around the world.

Benefiting Women and Children

Solar cooking is essential for survival in third world countries. Women and children can benefit the most from cooking with the sun. Cooking wood-

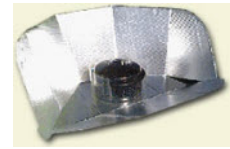


fuel is becoming scarce throughout the world, making it more dangerous for families to obtain, often needing to travel 10-15 miles from their village.



Simple Tools to Help Families

A nice solar cooker like the Global Sun Oven would be invaluable to a third world family, but a solar cooker can be made out of simple local materials like cardboard and aluminum foil. Refugees and orphanages throughout the world are relying more upon the free energy of the sun to stay alive.



CookKit Cardboard Cooker

2 Billion People Lack Clean Water

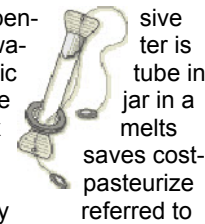
Finding clean water in many parts of the world is becoming harder every day. Believe it or not, a solar cooker can pasteurize water safely for drinking. Pathogens and harmful bacteria in collected water can be easily killed using sunlight. Solar cookers can be very influential in helping the health of families in sunny parts of the world by reducing the health hazards associated with cooking fire smoke and unsafe drinking water.



Water from mud hole

Simple Water Purification Indicator

This simple device is made out of inexpensive materials to help the user know when water is safe to drink. By putting this small plastic jar of untreated water, then putting the solar cooker, when the special soy wax the water is safe to drink. This method normally fuel normally needed to boil water to polluted water. This device is commonly as a WAPI.



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Organizations dedicated to train and distribute solar cookers to areas of the world that need them most. You can visit sunoven.com and solarcookers.org on the web.

Typical Emergency Problems Lessened

Food does not stick to pans, making less waste of valuable food stores, and clean-up is easier. Often in an emergency a pan can simply be wiped out with a paper towel instead of using valuable water for dish-washing. Because there is no heating source (except the sun), the food does not burn, stick to the pan, need stirring, or require constant attention as do other methods of cooking. Most solar cookers are light and portable. The Global Sun Oven weighs a mere 21 pounds and carries like a suitcase.

Safest Method of Cooking

Often during storms and other emergencies our utilities go out, along with our normal ability to cook food. Storing typical emergency cooking fuels and cooking with unfamiliar campstoves can be dangerous, especially for children. Solar cookers use no volatile fuels and are safe to use in stressful emergency situations. There are no dangerous flames and smoke. Nothing on the outside of the oven gets hot enough to burn a child. ☀️



Science Research at VTS

You can help spread the word about the gift of solar cooking to youth and others throughout the world.

UNLV's Earth Day



Safer Water with Solar

As NASA looks for signs of water on Mars, people on planet earth are polluting fresh water sources at an alarming rate. Disease is rampant in third world countries because of polluted drinking water. Half of the world's population has little or no sanitation systems to prevent contaminated drinking water and they lack any means to purify their water.

Recently on national television Bill Gates stated that 10 million children die every year due to contaminated drinking water. His foundation "The Bill and Melinda Gates Foundation" is spearheading world efforts to provide medicine to these children in order to prevent their deaths. The diseases transmitted through water affects countless adults as well.

Those of us with clean drinking water plumbed into our homes are a minority in the world scene. Most of us don't consider that our inexhaustible supply of clean water can be halted immediately if there is a natural disaster or if terrorists should happen to sabotage our water sources.

Simple inexpensive devices can utilize the Sun to pasteurize polluted drinking water in third world countries, thereby helping to eliminate rampant disease. These same devices can help us pasteurize water when camping or during emergencies. More sophisticated devices that utilize the power of the sun can provide clean distilled drinking water from any water source if our water utility is interrupted.

What is in the water?

While doing research for this article I soon realized that the topic of water was too large to review in a few paragraphs. It is hoped that you will continue your own research about the many pollutants that find its way into our drinking water.

Germs: Microbes exist in our drinking water but usually are not harmful. Other disease-producing bacteria, viruses and protozoan cysts, that are also found in water, are harmful. Utility water companies add Chlorine and chloramine as a treatment to kill germs. Protozoan cysts (cryptosporidium and Giardia) are hard to kill with disinfectant chemicals, so they have to be filtered. Escherichia coli (E. coli) is a coliform bacteria that can cause food-borne and waterborne outbreaks of disease with loss of life primarily among senior citizens and young children.

Boiling water rids the water of germs but can concentrate nitrates and pesticides in the water. Not all commercially available filters will filter out cryptosporidium and giardia.

Chemicals: Many chemicals that occur in nature can be harmful to your health (arsenic, radium, radon, selenium). Utilities test for 78 chemicals as regulated by the US Environmental Protection Agency (EPA). The EPA regulates 90 different contaminants, with 60 additional contaminants being studied. Many are caused by human activity: Dangerous

organic chemicals are found in gasoline, cleaning fluid, pesticides, paint thinners and radiator fluid.

Rainwater seeps through hazardous waste dumps polluting groundwater. Pesticides, heavy metals, and dangerous chemicals are washed into water sources from many man-made sources (farms, lawns, golf courses, de-icing roads, industrial plants, neighborhood streets, etc.). A visit to any city dump will scare the bejeezus out of you. Look for a sump or low spot where run-off collects. Not pretty. That stuff is getting into the ground water!

As mentioned above, utility companies add chemicals to our water for disinfection purposes, mostly Chlorine and Chloramine. Many water utilities add the debated chemical Flouride to drinking water. Lead that leaches into water running through old pipes has proven to be harmful to people.

With all this talk about germs and chemicals, we haven't even touched on other aspects of drinking water like dissolved solids that find their way into our water, and important factors like taste, odor and clarity.

Federal laws limit the amount of germs and chemicals that are allowed to pass through the water system, but it is acknowledged that we do get small quantities of these pollutants through our normal water delivery. Water utility companies do a great job treating our water so it is relatively safe, but it is advised that you develop a rapport with your local water district to find out more about your own local situation.

Flood of '72

When I was in Upstate New York in 1972 I witnessed the terrible flood that ravaged many areas as a result of Hurricane Agnes. Entire



communities were devastated. The flood waters carried every known bacteria and chemical from garages, shops, septic systems, sewer plants, stores and factories. It contaminated everything it touched. All food supplies, including can goods, had to be piled high in front of grocery stores so that front end loaders could scoop them into large dump trucks headed for the county dump. All power, sewer, phone and drinking water utilities were down. A distant brewery that was not affected by the flood waters stopped production of beer and started bottling water (in beer bottles) to keep people alive during the aftermath.

It is said that each person needs a minimum of a ½ gallon of water a day to sustain life. One gallon in desert regions. Three days without water and life is threatened.

Water Storage

Many families have opted to store water for emergencies. The amounts stored and the containers vary. We have an advantage over the folks of 1972. We now have a wide variety of bottled water we can

purchase at the store. No matter what we store, it may not be enough and we may have to resort to other means of obtaining drinking water. Natural or man-made disasters (even local emergencies) can be very stressful, with diseases being easily transmitted. We don't need to add to the stress by consuming contaminated water.

In an emergency we've heard that we can tap other common sources of water like our water heater, toilet tank, water bed, pools, etc. These may be sources, but don't count on them. They may be damaged in an earthquake or contaminated. Water beds are a very bad source of drinking water as they contain harmful toxic chemicals designed to keep out algae. Swimming pool water, unless distilled of all chemicals, will probably make you sick.

You've probably read information in survival books that describe various contraptions like digging a hole in the ground and covering it with plastic to collect water. This information is interesting, but you must exercise caution as building them may use up more water in your body than they produce. Also, they may not produce enough water to sustain life. Storage is more practical, especially in desert communities.

If one must resort to using what ever water is available, there are ways of making that water more drinkable.

Chemical Additives

As a Boy or Girl Scout, you have probably tried the nasty tasting iodine tablets available in camping sections of the store. These are to be used to sustain life when no other source of fresh water is available, and then in only small quantities. Chlorine and hydrogen peroxide and other chemicals can be used, but you have to know how to use them. A safer product, not readily available in everyday stores, is Ion (or similar product) that is a non-toxic, stabilized oxygen liquid that is added to stored water and reportedly kills pathogenic bacteria.

Filters

Filters that come in a wide variety are helpful while hiking, camping or in emergency situations. Y2k helped us learn about many different types, and many of us have these filters in our "72 hour kits" or "mobility bags" as recommended by FEMA and The American Red Cross. There are many to pick from; hand pumps, gravity fed filters and "under pressure" designs. You would need a 12 volt pump and batteries to operate the pressure kind if utility water pressure was not available. Most campers regard the Katadyn brand as the best for small hand pump units, while the larger AquaRain (and new Katadyn unit) gravity filters are said to filter out most harmful bacteria. The type you buy in the store to add to your kitchen faucet or drip in a container in the refrigerator takes



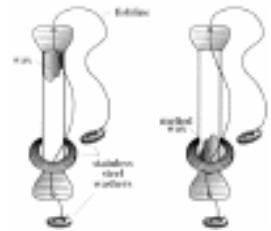
away taste and odor, but does little to filter out harmful bacteria, heavy metals and chemicals.

How the Sun can help

Solar cookers of all types will safely pasteurize water of all harmful bacteria. Thousands are in use in third world countries to help eliminate rampant disease. Millions more are needed in poorer areas of the world.

Through the ages we have been told that we need to boil water for five or ten minutes to make questionable water safe to drink. This is OK if you have the fuel. Millions of families in the third world do not have enough fuel, and in an emergency you may not either.

By heating water the "slow method" in a solar cooking device (home-made or commercial unit) you accomplish the same thing as boiling, only it takes longer. A simple inexpensive device called a Water Purification Indicator (WAPI) can be used to see when the water is safe to drink. When a small amount of soy wax is melted in the small plastic tube, the water has reached 160 F and the water is safe to drink. You can learn more about the WAPI at the Solar Cooking Archive web site operated by Solar Cookers International



When I give seminars to school age children on solar cooking I usually see a student with a clear bottle of water and I ask them, "did you have to get that water out of a river running behind your house? Did you have to dig a hole in your yard to find that water?" They laugh. Millions around the world have to get their drinking water every day that way.



While pasteurizing will solve a lot of disease problems, it does not address other things found in the water such as chemicals, pesticides and heavy metals. These need to be eradicated by distillation, and there is an effective way of using the sun to distill water from any water source.

During Horace McCracken's life, he became renown throughout the world as "the solar water distilling expert". He spent decades perfecting a device that would use sunlight as a power source for making clean drinking water. Most other devices that have been invented in the last thirty years have been patterned after principles that McCracken brought to light. One of his units has been in use for over twenty years on the coast of Baja where potable water is not readily available. Salt water from the ocean is daily poured into the



distiller, and by the end of the day up to three gallons of clear, clean, sweet tasting drinking water is produced using no other power source, except the sun.

Solar distillers can be home-made, but could be difficult because we would probably use the wrong materials for construction. Little information is available about "how to do it" because Mr. McCracken passed away before he could publish his exhaustive research. Commercial units are available. Popular ones include McCrackens, "SunWater" line, and another up and coming product made by Sol Aqua. Many large solar distilling systems are in operation in sunny climates throughout the world.



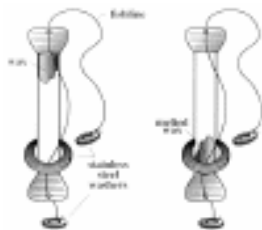
There are pros and cons about using distilled water for drinking water, but the fact remains that distilled water gets out all of the impurities that is found in almost all water sources. This includes all germs, viruses, chemicals, organic chemicals, pesticides, heavy metals, diluted minerals, and taste and odor causing contaminates.

Deep water wells usually produce germ free water, but should be tested yearly. Most wells require large 220 VAC pumps, but these can be converted to a reliable solar system thus eliminating the need for grid power and back-up generators.

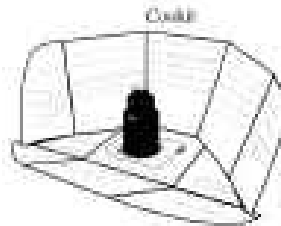
These effective devices can be used for every day use, and in emergencies as well. They certainly will be more important as the world finds its water supply getting more and more polluted with a myriad of contaminates found to be dangerous to people and animals.



WAPI - Water Purification Indicator



Soy wax melts at "safe" temperature



Any solar cooker can purify water

Costing pennies, this simple device can help save countless lives throughout the world. It can also help to purify questionable water in an emergency.



Solar Water Distiller

Do you want to live in a cabin with no running water by the ocean in Baja? Get a solar distiller and you can turn ocean water into pure distilled drinking water!

Turn any water source into pure distilled drinking water; Ocean Salt Water - Pond & Lake Water - River Water - Tap Water - Polluted Water - you name it.

The distiller needs to be level and you pour questionable water into one large hose and get pure distilled water out of a small tube.

We don't sell these any more but we know how to get one for you in a pinch.



Heat from the sun evaporates water in the tray. Moisture rises, condenses on the underside of the glass, runs into a collection trough, then empties into a bottle or tank. The condensed water, normally more pure than any bottled water, condenses in the presence of air. During this process it picks up oxygen, allowing it to taste "sweet" and pure. Two input tubes and two output tubes insure optimum convenience, with a minimum of maintenance.

The still is a shallow insulated pan with a sloping glass cover. The unit is constructed of "Polyiso" foam board that has been thoroughly coated with FDA approved silicone, and is reinforced with un-bonded glass fiber cloth. The frame and trim are made of sheet aluminum, which is also coated with silicone. Thus, everything that touches water is silicone. This same material has been used in solar stills since 1964.

Many SUNWATER Solar stills have been in continual operation for over twenty years. SUNWATER Solar Stills are manufactured by SUNWATER SOLAR in Woodruff, AZ.

Extend your camping experience, or make pure water at home, with a solar powered distiller. This amazing device pays for itself in a year or two by providing "better than bottled" water from literally any water source.



Solar Heating, Cooling and Refrigeration

My family lives in Las Vegas, Nevada, bordering the Mojave Desert, a relentless, hot region that includes Death Valley. After visiting the black asphalt covered downtown area called "glitter-gulch" a few times, my Dad always said that Las Vegas is the only place on earth that gets hotter at night. If the power ever fails in the summer months for a long period of time, people around here will be dropping like flies, or evacuating Sin City in droves. It is too hot to live here without the cooling effect of air conditioners.

The same can be said for those living in cold climates. It would be rather severe if families were to lose their heat source during a cold snap. Losing power due to natural or man-made disasters affects us in other ways, not the least is our refrigerator. Not only do refrigerators keep our perishable food cold, they also store important life-saving medicines.

The sun can help us with these three important needs in emergencies, but in order to prepare adequately, some thought needs to go into what options we have and what steps we can take. In previous articles published on earthtoys.com we discussed using the sun for emergency lighting and cooking. Today we will briefly discuss how to use the sun for heating and cooling our environment and ways that the sun can help keep our food and medicine cold.

Thermal Solar Energy

We all know that the thermal effects of the sun can heat our houses. Solar energy has been used to heat habitats for centuries and we do not need to go into depth about the sun and heating at this time. Passive construction, Trombe walls, thermal mass storage, home-made devices, greenhouse additions, and scores of other methods use the sun to capture heat. I recommend reading 'Fuel Savers, A kit of solar ideas for your home, apartment, or business' by Bruce N. Anderson. This book contains many ideas and projects about capturing heat from the sun.

Here in the desert, or anywhere the sun shines incessantly in the summer, we know that water in a black hose or pipe gets hot. No rocket science here. There are at least 65 different solar water heater manufacturers in the US, so information on heating water is readily available. What many may not know, is that many of these systems use pumps, controllers, timers and components that use 110 volts AC to operate. In the event of a grid power failure, these systems, unless modified, will not provide the needed hot water.

Using new technology pumps which are hooked to a small solar panel, homeowners can be free from utility power to obtain hot water. A new line of 12 volt pumps, called El-Sid are available in various wattages as low as 3.5 watts! This means an inexpensive 5 watt solar panel on the roof will turn the pump

on in the morning, and off at night when the heating effects of the sun drop below the horizon.

In addition to heating water for bathing, solar water systems can be used for zone heating. Metal pipes that circulate hot water are installed underneath the floor. Special check valves, and fittings must be used for zone heating and heating water in cold climates. Find a professional to "hook you up". Solar water systems have been sold for years, but the system I like is sold by Solar Development Co. (solardev.com)

Cooling

Cooling with the sun is a whole different matter, and there are NOT a lot of products or systems out there that will effectively cool homes inexpensively.

Though there has been a lot of research over the years on using solar for cooling, most are expensive, too large, and too theoretical. Most books on 'Solar Heating and Cooling' have only a small chapter on cooling and give no real good advice for the average person. Many areas of the world have basements or underground rooms that use natural cooling from the earth. We don't have that luxury in Las Vegas because most homes don't have basements. There are a lot of ways that you can construct your home for passive cooling, but most of us aren't going to run out and build a new house. A resource for those of us who need less expensive ideas, is contained in the book: 'How to Live without Electricity and Like it' by Anita Evangelista.

The problem with cooling is POWER. It takes a lot of it. Even homes that have large \$30,000 solar systems that sell power to the utility (grid-tie), can not produce the electricity needed to run home air conditioners in the summer. AC's take too much power. Even whole house evaporative coolers draw more electricity than most solar systems will produce. So, we have a real problem on our hands if the power goes out.

It is not fun being without air conditioning in the summer. Several years ago we had our house unit go out on the hottest day of the year. It was 126 degrees F in the shade and even hotter in the house. Fish were dying and we were miserable. After searching for two days I finally found a window swamp cooler that got us by until we could get the house air conditioner fixed.

There are small window solar run evaporative coolers that are available but they only cool very small rooms like a bedroom. Enough to get by though. They are specially designed to run on a 50 watt solar panel. We have sold



several of these units and our customers all love 'em. If you have enough PV wattage, you can hook these 'swamp' coolers to batteries to run during hot nights.

In an emergency there are small 12 volt portable swamp coolers called "Swampy's". These units come in different sizes and plug into a cigarette lighter. They draw a lot of power and will not cool an area, but it will cool off grandma temporarily in an emergency.

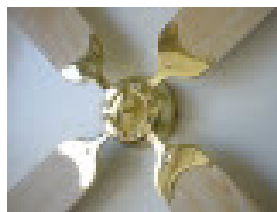
The problem of emergency cooling, if there is no utility power, is a very real concern of many families. Large noisy generators are all that will run compressor air conditioners. Though conceivable, solar isn't practical. You couldn't buy enough solar panels to do the job. The future looks bright on this topic because of the fast developing science surrounding 'fuel cells'. The down side is that it may be ten or twenty years before we see them used for the high power requirements of homes.

There are a few things you can do to soften the harsh heat of the desert, but most of them involve time and money. You may want to consider better insulation, solar attic fans, ceiling fans, low-e film on your windows, basements, shade trees, etc. There are many steps that you can take to lower the temperatures in you house, and lower your air conditioner utility bill at the same time.

Trees for Cooling

In 1991 I conducted a seminar discussing cooling in the desert in emergencies where I told the audience to plant shade trees. They laughed at my suggestion, but had they planted the right shade trees several years ago, their houses would be 20 or 30 degrees cooler by now. I learned from The National Arbor Day Foundation that there are quick growing varieties that will effectively shade an entire house with one tree. It may take several years for the small trees in my new yard to do much good for us. I have probably over populated our little yard with trees, much to the chagrin of my family. Oh well, I want a lot of shade here in the desert.

Recently I have found a new low voltage, low wattage (1.2 amps @ 12 VDC) ceiling fan that will be a great addition for those with 12 volt systems in their RV's, homes or cabins. As you know, ceiling fans don't draw a lot of power for the cooling effect that they produce, and now there are 12 volt models available in a variety of colors.



Refrigerators

The problems of power as it relates to air conditioners, also applies to refrigerators. Our normal kitchen refrigerators draw more power than most solar systems provide. There are special super energy saving refrigerators like the SunFrost and Conserve

that can be easily hooked up to larger solar systems and it is rumored that big appliance manufacturers like Maytag will be making similar models soon. It will be good news when these appliances become mainstream, as refrigerators typically draw more power than any other appliance in our home except the air conditioner. Super energy savers like the Conserve unit are a bit more expensive and they still need about 200 watts of PV solar power, eight golf cart batteries and a 1000 watt inverter to operate. This can get costly, but it works.

Often those off the grid who want to have a refrigerator use propane powered units similar to the ones we sell for RV's. There are several types available, but keep in mind that an RV unit requires a constant 12 volt supply to run the electronics in the refrigerator. There are a few free-standing 110 VAC / Propane units available. Some of you may even remember the old 'Servel' that ran on kerosene. These kerosene and propane units are available but hard to find as they are mostly sold outside of the U.S. We plan on carrying the full line of Servel refrigerators in the future, but I can't wait to tell you of a new refrigerator that uses new compressor technology that draws hardly no electricity at all.

But first let me tell you that most small portable units on the market may not be adequate for your needs (to keep food from spoiling or medicine cold enough).

There are several inexpensive, small, 'heat sink' type chest coolers on the market, but they only get 30 to 40 degrees F below ambient temperature. They may not get cool enough to protect your supplies. Cool enough for beer or soda, but not for milk. Our customers are not usually happy with the smaller propane RV type refrigerators, and real 'compressor' type chest refrigerator/freezers draw a lot of power (usually 4 to 5 amps @12 VDC). Most 'dorm fridge's' available at discount stores use similar high power draws at 110 volts. OK for short outages, but not practical for longer utility disruptions or life off of the grid.

OK, I am almost ready to tell you about the revolutionary new refrigerator that will solve all of your refrigerator problems. But first, let me explain that all of the refrigerators mentioned above, and all of the refrigerators you have at home, are built for two reasons: 1.) To keep food cold, and 2.) Convenience (easy to get the milk out). But when it comes to energy saving, their design is flawed. When you open the refrigerator or freezer door to get food out, what happens? The cold falls out. Yep, lost cooling, and lost energy. But, if you had a door that opened like a chest what would happen to all that cold air? It would stay put.

Super Energy Saver Refrigerators and Freezers

That's the idea of the new super energy saver refrigerator and freezer line called the *SunDanzer*, it opens from the top. Even better, the electricity it uses to operate is peanut's compared to all other

refrigerators or freezers. Are you sitting down? How does 8 watts at 12 volts DC sound? Remarkable? Yes, it is.



These new units are designed by a former NASA employee who used NASA technology to make the most energy efficient refrigerator or freezer made. There are two sizes of battery refrigerators and two sizes of battery freezers available. There's even a smaller refrigerator that hooks directly to a solar panel without using a battery. This fifth unit is great for medical clinics in third world countries that don't want to mess around with batteries.

The SunDanzer line has thicker insulation than anything I have seen, but the reality is, they all draw more power to cool as the surrounding (ambient) temperature gets hotter. You can see their actual draw by downloading the Residential System Sizing Chart at their web site (sundanzer.com) or pick one up at Vegas Trailer Supply (it is a pdf file so you will need Acrobat Reader to open it).

In mild climates the smaller refrigerator will take approximately one 75 watt solar panel and one or two batteries (deep cycle or golf cart) to operate. In hotter climates it may take a 100 watt panel to keep up. The larger refrigerator and both freezers will need more panels to keep cold. We tested the smaller refer in Las Vegas and it works great!

So, now we have a relatively inexpensive way to use the sun to keep food and medicine cold, and the over-all cost is about one third the cost of systems we sold in the past. Now we have a cost-effective way to use the sun to achieve a more independent lifestyle. The only draw back is that we have to get our milk out of the refrigerator in a different way than what we have done all of our lives.

Change is Good

Recently, I showed several solar devices including the SunDanzer refrigerator to visitors at a Log-Home show in Las Vegas. About half of the people who inquired about solar energy said that they didn't want to change a thing in their lifestyle. Others said "cool, I can do that". Hey, change isn't always bad. I remember watching a show on HGTV about a couple who went completely off of the grid. They mentioned that they had to change their lifestyle a little, but actually, most of it was for the better.

Last year we had a customer complain several times that the two 110 watt solar panels we installed on his RV were not working. He returned eight times to get his system checked, and each time we said that it was working fine. We finally found out what the problem was: Each morning when he arose, he turned on his 32 inch color TV and turned it off when he went to bed. I am sorry, but this is not a solar-friendly, energy-conserving lifestyle. He couldn't fit enough solar panels on his motor home to keep up with that energy draw! I am afraid that if one is not willing to change a little, then using solar is going to be very expensive indeed.

Independent Living is Preparedness

Solar energy can help us in many aspects of emergency preparedness. In past articles we learned about emergency lighting and cooking. Now we see how the sun can help heat our water and homes, provide a little cooling and keep our food cold during power outages. We also addressed using the sun to pasteurize, purify and distill ANY water for drinking purposes. When you think about it, independent living is preparedness. By becoming less dependent on others for food production and energy generation, we are more prepared to handle any emergency that arises.



12V Portable Fan

During the aftermath of emergencies or disasters when there are power outages there is often a need for cooling. During hot seasons this is not an easy task. This powerful 12 volt fan can make all the difference. CSA/UL approved. **(Available by SO at VTS)**



12V and 24V Remote-Control Ceiling Fans

This is a 42" four-blade ceiling fan with tan or white painted wood blades and a bright brass housing. The 3-speed reversible motor is controlled by infrared remote control and draws 1.2 amps (on 12V models) at high speed, .75 amp at medium speed and .5 amp at low speed. This fan is designed for surface mounting on a flat ceiling. An 8" swivel pendant mount for pitched ceilings is available as an option. They are available for 12- or 24-volt DC operation. CSA/UL approved. **(Available by SO at VTS)**

Safer Backup Power with Solar

August 14th was an eye opener for the 50 million people who were victims of the largest blackout in US history. I was amazed when CNN interviewed a man who was the hit of his neighborhood because he was the only person who had a battery operated transistor radio. His neighbors gathered around him for news and information about the power outage. I shook my head in disbelief as this man extolled the virtues of his radio as if it was a revolutionary new invention.

This power emergency was not unlike other disasters where people flock to stores for water, flashlight batteries, food and other basic supplies. Unfortunately, with each disaster we hear stories of dishonest vendors charging outrageous fees for necessities. People just don't prepare enough.

Though not essential to life, electricity is one of the things we would miss the most during and after a disaster or regional emergency. This is evidenced by the thousands of generators sold before an impending hurricane. A safer option is to use sunlight to create power during these stressful periods. You don't need solar for back up power, but you do need solar if you want to quietly recharge your backup battery bank on a daily basis. Please read part one "Safer Lighting with Solar" for an important discussion on generators that most people haven't considered. Photovoltaics (PV) panels don't pollute and they are quiet so they don't draw unwanted attention.

Lighting is probably the most important use for backup power. We need light to see what we are cooking and eating, to go to the bathroom, read, and take care of medical needs. The problem with flashlight batteries is that they run down quickly. Candles and other flame sources are dangerous and should not be used. The lighting article also suggests ways that we can use light to keep our families safer during emergencies so that an inconvenience does not turn into a disaster.

In addition to lighting, a reliable power supply is needed during power outages for communications. On-board batteries won't last long in radios, TV's, CB's, cell phones, walkie-talkies, shortwave radios and VHF radios. Other needs for power include; cooling, heating, refrigeration, water pumping, laptop computers, and even entertainment.

This last August the media reported that 3000 people in France died in one week due to a heat wave. Most solar systems are too small to handle air conditioning, but small backup battery systems can provide power for fans, and small evaporative coolers, providing comfort during heat waves. The suggestions in part three of this series 'Heating, Cooling and Refrigeration' may help you avoid a similar tragedy.

A safe and renewable source of emergency power is important to have during emergencies, but the most common way to store that energy is lead-acid batteries, and by their nature they aren't safe. There are many books and articles about safe use of batteries. We suggest you study up on this "weakest link" of a backup power system.

Lead-acid "wet" or "flooded" batteries need frequent maintenance and care and there are other types of batteries that are less trouble. Gel-cell batteries do not require checking the fluid levels regularly. There are other batteries that act like a gel-cells, but store more power. They are sealed lead-acid batteries like the Optima or Concorde brands. These batteries can operate on their side or even upside down because they won't leak or spill when accidentally tipped over. While all storage batteries create explosive gasses when charging, these batteries "fume" less and are typically used in Wheelchairs and interior locations. They are a good choice for a home-made portable backup system or a commercial one similar to the XPower Portable Household Inverter. These sealed batteries are more expensive and they still can create a dangerous explosion if the terminals are shorted out.

Most solar systems use the typical 6 VDC golf-cart battery because of their ruggedness and lower cost. Smaller systems in Recreational Vehicles (RV's) often use 12 VDC "Deep Cycle" batteries. Typical automotive batteries will be unsatisfactory in all but the most dire of emergencies.

WARNING: CAREFULLY HEED ALL BATTERY MANUFACTURER WARNINGS. BATTERIES CAN ARC AND BURN OR EVEN EXPLODE. THE ACID INSIDE WILL BURN SKIN AND BLIND EYES. IF YOU DO NOT UNDERSTAND THE MANUFACTURER'S WARNINGS, PLEASE SEEK ASSISTANCE FROM QUALIFIED PROFESSIONALS. THIS ARTICLE DOES NOT ATTEMPT TO TEACH YOU BATTERY CHARGING AND TESTING SAFETY. READ MANUFACTURER'S RECOMMENDATIONS FOR BATTERY CHARGERS, HYDROMETERS, INVERTERS AND BATTERIES.



Most battery manufacturers have safety information and maintenance tips on their web site but I like Trojan's 'Battery Maintenance' (trojanbattery.com) information pages because they give important information in a straightforward manner. The key to achieving optimum performance and long life is a solid battery maintenance program similar to the simple procedures outlined on these pages.

I wanted to include the Trojan battery maintenance information in this article, but I couldn't list everything and I felt it important that all of the information be read. It outlines the equipment needed, inspection of batteries, specific gravity testing, open-circuit voltage testing, watering, cleaning, storage, charging, equalizing and discharging information.

A 6-24 hour chart is shown in the Trojan info so you can periodically test the true condition (with a digital voltmeter) of your batteries. Though less accurate, we find it useful to use a simple one-hour chart for a quick test. RV'rs typically use this chart an hour after sunset on a daily basis. Any readings done during charging, or before the hour waiting period will result in false, higher readings. Until you have it memorized, I suggest you print off this chart and laminate it to keep it readily available.

One Hour Battery Condition Chart

Please see the one hour battery condition chart shown in the article "A not-too-technical discussion of solar and RV batteries"

Safety First, Second and Third

In any back-up system the batteries take the most effort to maintain and they are the most likely part of a system to fail. If you follow the suggestions given by Trojan, you will have batteries that give you optimum performance with a longer than normal life expectancy. Remember to properly vent your battery storage compartment and follow all safety recommendations. Wear safety goggles and other protective gear when servicing batteries. Keep a box of baking soda nearby. Extreme cold and heat, as well as storing them in a discharged state, will reduce the life of your batteries. Always have a high respect for batteries when around them because they can be very harmful if not handled properly.

Controllers

When charging solar batteries, a controller should be installed between the solar panels and the battery bank to prevent the batteries from being overcharged. Choose a controller with a digital voltage meter read-out so you can constantly be aware of the charge state of your batteries. Controllers need to be set for either lead-acid or gel-cell type because both require different cut off voltages. There are many types of controllers available. With small systems it is not critical which brand you get, but with larger systems you will want to do your homework.

Fuses, Breakers & Disconnects

All battery banks and circuits should have the proper fuses, breakers and disconnects installed to protect from shorting out wires or the battery itself. Wires can melt and cause a fire when too much current flows through, and all batteries can explode, spewing dangerous acid.

Other Chargers

If you are using a 110 VAC charger to keep your battery bank full of power, please use a charger that has a three-way charge. A three-way unit charges bulk (2-10+amps per hour), trickle (1-2 amps) and float (off to 1 amp). Most auto store chargers will not charge your batteries properly because they do not have the float cycle that shuts completely off when the batteries are full. Batteries left charging, even at a trickle, can boil away, ruining the battery. Most converters that come standard in RV's are bad for batteries because people forget they are constantly charging when the RV is plugged into 110 VAC "shore power". Our most popular 110 VAC three-way charger is the TrueCharge line. Some high-end inverters do double duty as they have three-way chargers built in to their circuits. A good three-way charger will noticeably lengthen battery life.

Inverters

Inverters convert the 12 VDC from your battery bank to 110 VAC so you can run regular appliances. There are a wide selection of inverters on the market and technology has made virtually all of them more reliable and less expensive. The type of appliances you can operate depends on the size of inverter and battery bank capacity. We suggest that you never let your batteries get below 50% discharge and that you regularly only see a 20-30% discharge before you re-charge your batteries.

New Solar Products

There are several new products that can be valuable in an emergency, or just to make life a little easier along the way. One item I found at an RV show a few months ago was the PowerDock that is a portable mini power generating station capable of storing 9.2 amp/hrs of 12 volt electrical energy. The PowerDock has a heavy duty fifteen watt solar panel that charges a built-in dry-cell battery that allows you to operate your laptop, stereo, TV, cell phone, fan, light, etc. around the clock. It also allows you to charge your low-voltage equipment without using your auto battery. This rugged power station folds compact for portability, has two automotive cigarette lighter receptacles, two standard connectors, a built-in charge controller, power meter and a canvas jacket designed to hold accessories and your laptop.



A product that is great for emergency power is flexible solar panels that come in various sizes and fold up for easy storage and backpacking.

Another new product I found in the local home center store was a solar candle. For years I have used the small solar landscaping lights with the small LED light in them that don't have wires. The same thing is now available that will sit on a table. A few of these on your patio charging up will be a great



renewable light source for your kitchen if the power ever fails.

There are many types of solar landscape light sets on the market in home centers and box stores. Many of these could be used as emergency lighting.

I expect LED lights to be more and more popular as the price comes down. This amazing bulb doesn't ever need replacing because it will last for thousands of hours, and they use very little electricity. Light bulbs with various numbers of LED mini bulbs in them approach the light output of regular bulbs, but they cost an arm and



a leg. I also look forward to fiber optics to bring free light into our houses in the future.

With a little thought and preparation, you can solve many of your electrical needs safely in the event of an extended power outage. The do-it-yourselfer might want to make their own portable solar power supply, or put a 12 volt motor in a small swamp cooler to solve those electrical needs. We are lucky to be living in these times, independent living is a little easier for us than our grandparents.



Ultra Energy Efficient Refrigeration: SunDanzer

Save energy and money with SunDanzer® DC refrigerators and freezers. These ultra efficient solar refrigerators and freezers have exceptionally low energy consumption requiring smaller, less expensive PV or wind power systems.

SunDanzer cabinets are designed with much thicker insulation than typical appliances which allows them to operate on a modest energy budget, ideal for off-grid solar homes, or in applications where grid electricity is not reliable.

Every SunDanzer is carefully engineered to provide outstanding energy efficiency and high reliability. Low energy consumption is the key that allows SunDanzer refrigerators and freezers to be cost effective in renewable energy systems. This technology allows refrigeration in remote locations where it was previously impractical or unavailable. Since these units operate directly on DC inverter energy losses are avoided and inverter reliability is never a concern. SunDanzer's founder served as NASA's technical lead for advanced refrigeration technology and continues to support NASA in refrigeration technology development.

Two new small ultra energy savers that we now carry will add portability along with energy savings. The refrigerator (DCR50), requires only a 45 watt solar panel and one battery to keep food barely above freezing. The 50 liter units will operate on 12 or 24 volt DC. The freezer draws more power than the refrigerator so it will require a larger solar panel.



Our most popular size SunDanzer (5.8cf) now is available in an AC/DC model that will run on 12/24 volts DC and 120 volts AC! How does 4 amps DC or .4 amps AC sound? One reason these



SunDanzer units are so incredibly energy saving is because they are chest-type so the cold doesn't leak out when the door is opened.

Models Available;

<u>DCR50</u>	<u>12/24vdc 1.8cf (50liter) Refrigerator</u>
<u>ACDCR50</u>	<u>12/24vdc & 120vac 1.8cf Refrigerator</u>
<u>DCR165</u>	<u>12/24vdc 5.8cf (165liter) Refrigerator</u>
<u>ACDCR165</u>	<u>12/24vdc & 120vac 5.8cf Refrigerator</u>
<u>DCF165</u>	<u>12/24vdc 5.8cf (165liter) Freezer</u>
<u>ACDCF165</u>	<u>12/24vdc & 120vac 5.8cf Freezer</u>
<u>DCR225</u>	<u>12/24vdc 8.1cf (225liter) Refrigerator</u>
<u>ACDCR225</u>	<u>12/24vdc & 120vac 8.1cf Refrigerator</u>
<u>DCF225</u>	<u>12/24vdc 8.1cf (225liter) Freezer</u>
<u>ACDCF225</u>	<u>12/24vdc & 120vac 8.1cf Freezer</u>

Underlined models normally stocked at VTS. Other models are special order (1-10 weeks).

The SunDanzer line is normally used for homes off the grid or cabins with solar power. The low power use means much smaller (less costly) photovoltaic systems for the owner.

These units are ideal for those concerned about back-up refrigeration for critical medicines or perishable items. The DC/AC versions will operate on AC power and if there is a disruption of grid power then the unit will switch to



Put the fish on ice!



Getting food out of a chest refer

DC backup power. Once the 120 volt power is restored the control will wait 5 minutes then automatically switch back from DC to AC power.



Live Safer (and Better) with Solar

The times that we live in warn us that we need to live more independently from the outside controls of others, especially the dictates of oil, both foreign and domestic. We need more preparedness for the spears that modern day throws at us, including more "home production" that was common place to our grandparents just fifty years ago. Any steps that we take to increase our self-sustainability and independent living increases our safety and freedom from negative influences of the world. Solar is a tool that helps us build a foundation of safer living during unexpected emergencies as well as providing a higher level of security during everyday life.

There are many steps we can take to better prepare our families for emergencies. The American Red Cross, FEMA, and scores of other organizations have excellent publications available to instruct us on specific steps we can take. Nowhere have I found in these reports a discussion how solar power can be an aid to families in emergency planning. With the help of earthtoys.com we have made available five articles that deal specifically with how solar power can make your family safer before and during emergency situations. Each of these articles are linked below for your consideration.

Water

Paramount to life is water. It is said that we can live only three days without water and many organizations are suggesting that water be stored by families "just in case" it is needed in an emergency. Solar cooking devices can pasteurize questionable water sources of all bacteria and germs and solar distillers will eliminate all other contaminants like heavy metals and pesticides from virtually any water source. Learn more: 'Safer Water with Solar'

Food

Several years ago we saw victims of the San Fernando Earthquake stand in long food lines for hours because they took little or no steps in food storage and emergency cooking preparations. Our society does not promote these concepts, but if you gradually build up your food stocks you will probably be thankful you did. We've heard that it is possible to live for three weeks without food, but any one of us who has watched the TV series "Survivor" knows that life can be rough just a few days without food.

Solar cooking can provide many safety benefits that you may not have considered. You are invited to check out 'Safer Cooking with Solar' to learn more about this important aspect of solar energy. The article neglects to mention that solar cookers are also used to "can" or "bottle" fruits and vegetables and you can also make a solar dehydrator to dry foods for storage.

Power for Lighting

Most regional emergencies like hurricanes, earthquakes or winter storms, are accompanied by power

outages. This year we witnessed the largest power outage in US history. It was not a result of a natural disaster, but it did cause many severe problems for millions of people. Often during these power outages people use a myriad of unsafe lighting devices which can turn an emergency into a disaster. Part one of this series, 'Safer Lighting with Solar' discusses why low voltage lighting is safer than other lighting alternatives and it also discusses little known reasons why gas generators are not a safe method of power generation during power outages.

Power for Other Needs

During emergencies power is important for other needs like cooling, refrigeration, communication, heating, or even recreation. Solar can provide the power to keep these systems running if you take the time to learn how it is done. If you are concerned about keeping perishable food or medicines refrigerated during power outages you will want to learn about the new solar refrigerators and freezers made by SunDanzer. These new revolutionary appliances are becoming more popular, and they are reasonably priced. You can read more about the SunDanzer and other aspects of safer power in part three and five; 'Solar Heating, Cooling and Refrigeration' and 'Safer Backup Power with Solar'.

Peace of Mind

Many people don't think about preparedness until an emergency situation is imminent. The problem is, most emergencies and disasters do not announce themselves ahead of time. They are quick and sudden. Preparations need to be made ahead of time, before they are needed.

Having a plan, and doing something about it brings a level of peace of mind to you and your family. You may never be able to prepare enough, but anything that you do can be important, and that is assuring. The American Red Cross tells us in their publication on terrorism, "Taking preparatory action can reassure you and your children that you can exert a measure of control even in the face of such events."

It is hoped that you never need to use your preparedness plan, but if you take steps now, you will reap benefits from the peace of mind that "you are prepared". Your experiences and lessons can then be shared with other friends and family members who will also gain from taking positive steps towards preparedness.

Enjoy Nature Safer

What do you do when you want to experience the natural wonders of the outdoors when it is not safe to use a fire to cook food? During drought conditions your family can use a solar cooker and still enjoy nature. The 21 pound commercial Global Sun Oven is often used camping and there are simple lightweight cardboard cookers that can be folded up and packed in a backpack. Solar cookers do not use

flame so they are absolutely safe to cook in the middle of a dry forest. Battery powered lights are a safe alternative to flame lanterns and with the new flexible solar panels mentioned in 'Safer Backup Power' you can take TV's, cell phones, GPS devices, walkie-talkies or laptops into the wild.

Many families use a Recreational Vehicle (RV) to better experience life outside of the city. An RV can also be an effective emergency tool because they come with all the systems that make it a complete "home on wheels". I have been in the RV and solar business for over 20 years, and many of my customers have their RV equipped with emergency supplies "just in case" there is a need. An RV is ideal for solar, especially if you like to "boon-dock" in remote locations. You can power your lights, water pump, and electronics with photovoltaic (PV) panels, cook your food with a Sun Oven, make drinking water out of pond or ocean water with a solar distiller, and take a shower with water heated by the sun. With a little food, no telling how long you could stay on that deserted beach in Baja.

Majesty of solar

While solar is an environmentally responsible way to save energy, provide safer power during emergencies and provide measured benefits to daily life, the real majesty of solar is found in the good that it can do for others who need it most.

Literally half of the population of the world lack basic necessities like grid power, a regular cooking fuel supply, household water plumbing and sanitation systems. Solar devices can bring relief to hundreds of millions of people who need it desperately. Great strides have been made to get solar lighting and cooking devices to these people, but we have much more to do.

A single PV solar panel, battery and a low voltage LED or fluorescent light can provide a light source for a family that has never known such luxury. Now chores and scholastic studying can be regularly done in remote locations, night after night.

Solar cooking can provide much needed relief to countless women and children who are burdened with the task foraging for fuelwood (wood, sticks, grasses and dung) to cook their meals. Solar cooking also eliminates smoke from cooking fires that is a cause for enormous health problems to families in third world countries.

A village that has deforested their surroundings for want of cooking fuel can turn to solar power to renew and heal the forest. Not only will the forest regain its productive strength and habitat, it will improve the local watershed, providing cleaner water with less pollution and disease.

Cleaner water, an endless supply of cooking energy, and a means to become more productive and educated will result in stronger individuals, families, communities and nations. Our efforts need to be magnified ten thousand times if we are to accom-

plish our goals, yet the smallest effort is vitally important. One 5 dollar cardboard cooker can make a life-saving difference to a family without local fuelwood or the means to purchase cooking fuel.

Because of the great good that solar energy provides to people, the environment and dwindling habitat, it is hoped that you can do your part in spreading this information to others. Members of all environmental groups, care organizations, churches and civic groups can make a difference in the world by getting personally involved to bring this wonderful gift to those who need it most. Members of these groups will find that solar can further advance the established goals of their organization. Solar power gives you the power to do good and provide added safety for your family, your neighborhood, your group, and for others across the globe.

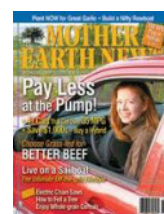
To find out more

A larger ebook publication is currently being developed that gives more details about using solar for emergencies. This publication will include a list of resources and several plans for building your own solar cookers. The ebook will be available at no charge to those who ask for it. *(Note: this publication in pdf format is the result of the mentioned ebook.)*

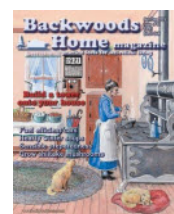
If you live near Las Vegas or are planning on a visit, please stop by Vegas Trailer Supply to see many solar energy products for independent living. We also have a solar reference library with several books in our store that you can review. Our website, vegastrailer.com, has various solar information pages available for download.

Solar links the ways of the past with technologies of today to help make life on our planet easier and more secure. Tomorrow promises greater technological advances and greater social responsibility to share them with all who can benefit. Solar can assist us in our emergency preparedness by helping us live more independently.

I hope these articles have given you cause to ponder the untapped power that solar can provide. Whether rich or poor, all of us can take steps to make this world a more positive and safer place to live. You are invited to visit my web log (blog) that discusses solar and preparedness topics and I welcome any comments you may have. The Solar for Emergencies blog is located at <http://solarguy.blogspot.com>.



To gain more insight on solar power and independent living pick up a mag at your favorite bookstore.



Mother Earth News or Backwoods Home Magazine

Communications in Emergencies

During emergencies or disasters most electrically operated communication devices shut down. They need power to operate, but with a little preparation, most communication devices can come alive when they are needed most. Solar panels or small wind generators generate power, batteries store power, and inverters will power or charge the communication devices. Though not readily available, small 12 volt or solar operated flashlight battery chargers are invaluable in extended power outages.



Short Course on Emergency Communications:

AM/FM Radio

In the 50's the invention of the transistor radio was heralded as a revolution in communications. When it comes to emergencies the problem is, most of us do not have one of these things available with fresh batteries. During the East Coast power outage in 2003 the news media picked up on a fellow who had one and took it outside for his neighbors to listen. This event actually got national news coverage because most people in the blackout had no battery powered radios to keep informed. Unbelievably sad, but true. Most radio and television stations have back-up generators to transmit emergency communications but we need the minimal equipment to hear or watch it!

Television

Small television sets are available with 12 volt or battery operation. They are available in color or black-and-white, and are readily available and inexpensive.

Email/Internet/WiFi

When the power is out our computers will be out too. No email, no internet access. All aspects of the internet run on electrical power, including our computers. Even if we use a lap-top with batteries, there probably won't be any internet to log on to. Enter Solar Powered WiFi! A community in Colorado is investing in a local solar operated wifi system just in case the power goes out. About time!

Cell Phones

Of course we know that in a power outage cell phone towers are out too, but not all. During the aftermath of Hurricane Katrina many residents stuck in attics used their cell phones to call for help. The batteries didn't last too long so some means of charging the batteries should be addressed. This popular essential device could save your life if proper preparations are made.

FRS/GMRS/Walkie-Talkie

Most walkie-talkie devices are short/medium range (2-15 miles). These are good if everyone in your

group or family has one and a plan is in place for frequency use. Batteries are needed so a way to charge flashlight batteries should be devised.

CB

CB's have a longer range and most of us don't use them any more. Too much cussing and horsing around on the air-waves. Here's where de-regulation killed the popular use of them. Most truckers have CB's because they are invaluable for the road. Most CB's operate directly off 12 volts so a solar powered low voltage system is ideal.

Shortwave/VHF/Amateur Radio

There's nothing amateur about amateur radio! If you are not a HAM operator, get to know one in your area. You can usually find them by the various types of antennas in their yard. During virtually every disaster HAM operators are very active providing emergency communications. During Hurricane Katrina 500 amateur radio enthusiasts were providing about the only emergency communications service in the Gulf. Check out ARRL.org for more information.

You need a special FCC license to operate this important equipment, and there are various levels of participation. Larger back-up power is needed as most of these specialized radios take more power to transmit long distances. Shortwave receiver radios can listen in on local police/fire department frequencies and communications world-wide. These receiver radios are available to everyone, but try to get the largest and highest quality one you can afford.

Scanners

If you don't want to transmit information on these special radio frequencies, you can listen in for important information by scanning the police, fire department and emergency responder frequencies in your area. Most scanners need the local frequencies to be programmed in the radio, but this is a simple procedure. Small battery operated hand-held scanners, 12 volt DC scanners and 120 volt AC scanners are available at your local Radio Shack or Electronics dealer.

GPS/Satellite

Technology changes daily. During local or regional power outages the satellites still are doing their thing out in space. If you have a device that operates on a satellite signal, then chances are it will work during a power outage, providing you have back-up power to operate the device here on earth.


Manual/Visual

Boy Scouts learn morse code, mirror signals, hand signals and other forms of short to medium distance communications. It might be a good idea to learn a few of these methods.

Learn more about emergency communications:

Subscribe to Popular Communications. Buy the book "The ARRL Emergency Communication Handbook" from ARRL website. An ARRL book: "Emergency Power for Radio Communications". Other books available on amazon.com: "Guide to

Emergency Survival Communications" and "Communications for Survival and Self-Reliance"

Check out Sundance Solar for solar operated radios. A link to Sundance Solar and other sites are available through solarprepared.com. 

Solar Evaporative Coolers

A couple of years ago a customer wanted to power his 3/4 horsepower swamp cooler with solar power 24 hours a day, 7 days a week. Often I get customers who want to run their airconditioner on solar power here in the desert (Las Vegas area).

The gentleman who wanted to run his swamper on solar was astounded when we worked out the number of solar panels and batteries that he would need to accomplish his request. He also would need other parts to his solar system that made the cost prohibitive.

Those people who want to run their energy-guzzling airconditioners constantly on solar panels are amazed when they find out it is rarely practical to do such a thing! If you are connected to the grid, and your cost per kW is 11 cents, it will take you a long time to get pay back on your investment. Now, I'm not advocating not to use solar power. Many who require huge amounts of power do use solar power and they are happy doing it. I am just saying that one should look at alternatives and research the options before jumping into huge systems.

Many times people will consider life-style changes to accomplish their solar dream. Often these lifestyle changes are for the good, though change is hard.

Ghost and Vampire Loads

Anytime you are relying upon battery power supplied by solar or wind energy you need to be aware of the many hidden ways your valuable power can be wasted.

Any appliance that uses a remote is always drawing power, even when turned off. Televisions can be using up to half of the rated "on" power when turned off. That means a 200 watt TV can be wasting 100 watts per hour when not running. This will use valuable battery power that should be used for other things. This is especially true if you are using an inverter to power your appliances because the inverter uses power any time it is running.

Other appliances that have clocks or timers like microwaves, radios, DVD players also use power when not performing their intended function. Electrical power to these devices should be completely cut off when not in use.

One of the options for cooling is the Solar Chill evaporative coolers designed for solar systems. These quality evap coolers are made in the heart of solar country, Arizona, but they may not be as powerful as a 3/4 horse 5500 cfm cooler you buy at Home Depot. Perhaps you can cool part of your house, or get multiple coolers for different areas and only operate them when someone is in the room. Either way, you will require less power with this small life-style change.




Over the years we have sold small room solar run coolers similar to the Solar Chill and if people understand their limitations and their energy saving benefits, they love 'em!

Check out the Solar Chill Evaporator Coolers on the web at: <http://www.solarchill.com>. 

The same goes for those tools, laptops and cell phones that have a plug in box (transformer) that charges a battery in the device. When the battery is fully charged these nasty black boxes (called vampires) continue to use power. Just touch the box when your drill is fully charged, it is warm to the touch! This device is sucking up your valuable electrical juice.

What about that shaver that stays plugged in on your sink? These ghoulish devices may only use a "little" power, but they are typically on 24 hours a day, adding additional costs to your electric bill that is totally not needed.

Our society has not got around to making conservative appliances, or houses for that matter. You can save energy today, even if not using solar power, by unplugging these ghosts and vampires.

In an emergency situation it is critical that you save all of the power you have managed to scrape up so that you can operate the important stuff. 

Baking Fresh Ground Whole Wheat Bread with a Sun Oven

The staff of life is bread and there is nothing better than home-made bread. It is healthier than store bought and it is cheaper and better tasting. Here is a recap of my method of making fresh-ground whole wheat bread using the Whisper Mill, Bosch Mixer and Global Sun Oven (or a regular oven).



Some of Mikes bread cooked in a Sun Oven

The way I make bread was taught to me by a friend in Las Vegas. I originally learned to make white bread from my Mother where we use white flour and it took a lot of kneading (your finger nails got clean though) with two "rises" to make the bread. Probably one of my fondest memories on this earth is Mom's home-made bread. Absolutely nothing tastes or smells as good!

I mostly make fresh ground whole wheat bread now and in my old age I let a machine do that hard kneading.

Whisper Mill

I grind my wheat in a Whisper Mill. It takes just a few minutes, and fresh milled wheat is much better for you than anything you can buy in a store, even health food



stores. The Whisper Mill is supposed to be quieter than other brands but it still will wake up the house if I use it too early in the morning. It is an impact grinder instead of a stone grinder. It produces very fine flour and takes only a couple of minutes to grind the wheat. Once the grain is milled into flour, it starts to lose its vitamins immediately. Even store bought whole wheat grain flour is missing a lot of the real value that the wheat kernel offers. Though we can't really notice it, the oil in the wheat kernel goes bad in just a day or two, and it is said that fresh ground wheat should be used within a half an hour after milling.

I know fresh ground wheat bread tastes better than anything you can buy, even those six dollar loaves in health food stores. The reason it tastes better is because more of the good stuff is in the bread. It has been said that almost all of the good stuff has been taken out of white flour. The wheat germ is gone, the oil, the bran and other stuff.

I make different size batches, depending on my method of cooking. If I am cooking in the Global Sun Oven, I make a smaller batch because the darn little cooker only cooks so much. When using the Sun Oven I usually make 6 loaves and cook three at a time. This last time I made 8 loaves, three large and

five small loaf pans, because it was cloudy and I like the smell of cooked bread in the house anyway. We immediately freeze the loaves for fresh taste and just take out a small one a few minutes before dinner (more on that later).

While I am grinding the wheat, I usually throw in a small handful of barley, oats and flax seed for a little extra nutrition and flavor. I don't use too much of the grains besides wheat because they don't have the needed gluten. The gluten is what makes the dough sticky and pliable. The flax seed has a lot of oil in it so I add it and the other grains while I am grinding the wheat.

I use Montana wheat because the protein is higher than most brands and they say it is the best wheat in the nation. I have mixed in some of my red turkey storage wheat from Utah and other types of wheat with my Montana stuff and everything turns out fine. Other brands and types do not have as high of protein and some have said that other wheat doesn't rise as well, though I have not tried other brands alone.

The local kitchen store gets their Montana wheat shipped in on pallets. Call around to local bakeries to see if they will sell you a few bags of Montana wheat if they use it. In Vegas I buy my wheat at Bosch Kitchen Store clear across town. The wheat is expensive, and prices are rising almost daily. This week I paid \$35 for hard red wheat and the hard golden yellow (white) sells for 45 bucks a 50 lb bag.

I grind about six cups of raw wheat. It makes about 9 or 10 cups of flour. The way I was taught to make this recipe you do not use an exact measurement of flour. Each time the amount of flour varies slightly. So, if I don't have enough ground wheat flour I add a little white flour until the dough is just right. If I grind too much for that day then I freeze the remainder and hope I use it within a couple of weeks.

Bosch Mixer

I use a Bosch mixer for the mixing and kneading. It is expensive, but worth every penny. The Kitchen Aid mixer is just not strong enough for bread, as the motor gets hot and will shut down or burn out if you are not careful. The Bosch eliminates the need for kneading. The Bosch is so powerful; it only takes ten minutes after the ingredients are in it! And NO double rising period is needed.

It would take three hours to form the proper gluten in whole wheat dough with a Kitchen Aid mixer, or more if kneading by hand. In a powerful Bosch it takes only ten minutes to form the gluten in fresh ground wheat dough. Of course, when using high gluten white flour you can do it by hand or in a regular mixer.

First you put in 4 cups of very warm (not HOT) water into the Bosch bowl. Next add a half of a cup of

butter or oil. Any oil you like will do. I use olive oil but vegetable oil or butter will work fine. Butter seems to make the bread a little moister and richer.

Next add a half of a cup of honey. I next add a tablespoon of brown sugar and if I want the bread sweeter I add a little more sweet stuff. I put the honey in the same measuring cup after the oil, because the honey doesn't stick as much.

Next add the yeast, 1½ to 2 tablespoons is great. I turn on the machine for a second or two to mix up the yeast with the water and sweet stuff. This gets the yeast going and bubbles start to form in the goop. I use the granular stuff and buy it by the pound in the vacuum bags from Sam's Club. The little packets are way too expensive. Keep yeast refrigerated. They say that the yeast only keeps for a few months, but I am using 6 year old yeast and it works just fine. Is it because it's dryer in Vegas?

Then you add a couple of tablespoons of "dough enhancer" and "gluten". These are not essential but I like to use them. They should be available from a kitchen center. I usually get mine from a local store, so I really don't know where you get the stuff in other communities. I sometimes buy a small box of gluten flour at a Walmart that works fine.

Next, add four tablespoons of powdered milk. The machine is off now and the powder stuff is just sitting on the water goop. Next I put about six cups of my fresh flour to cover the water. I then put in the salt. It's about 1 1/2 tablespoons though now I use a little less because of my low salt diet and the bread turns out fine. I don't put the salt in the goop because salt kills the yeast. I put it on top of the first batch of flour so it will be mixed up gradually when I mix up the flour with the liquid.

Turn on the mixer and the mixture will be very soupy or thin. Next you add flour until the mixture is right. No, you don't measure the flour. You just scoop it in. That is what I meant about variable measurements. Every time it takes a different amount. I can't explain it, it just does. Something to do with the humidity..

Keep adding flour until the dough gets thick and starts to separate from the side of the mixing bowl. Be careful here, watch it close and when it is getting close, just add flour a tablespoonful at a time. Watch the lower edge of the bowl, and when the dough just stops sticking to the bowl, stop adding flour. If you run out of ground wheat flour and it is not at the right stage, don't stop and grind more wheat. You don't have time. Just have a little white flour handy and add a little until the mixture is right.

When right, set your timer for ten minutes. Not a minute less or a minute more. Keep the dough mixing for the entire ten minutes.

Cooking Spray (oil)

Spray your hands, knife (to cut the dough) and bread board with cooking spray. Do NOT use flour on your bread board. Empty dough on board and cut it with a sharp knife, dividing into loaves (more below). Put about half of what the size of loaf you want in the loaf pan. Let it rise in a warm area until it has doubled in volume. I use the microwave chamber for a couple of loaves, as it is a perfect environment. (Don't let anyone turn it on, ha ha.)

If it is chilly I put the pans in the cold oven with a pan of hot water on a shelf to add humidity. Most of the time, in this desert climate, I spray the top of the loaves with a quick shot of cooking spray. There are specialty sprays that are better, but I find any cooking spray works great. This prevents the rising dough from drying out and gives it a softer crust. Some people like tofu powder instead of powdered milk, but I have so much I use the milk.

As mentioned above, I cut the dough with an oiled **sharp** knife, and then form the dough into a ball by rotating it on the oiled board with the palms of my hands, all the time pushing in at the bottom forming a perfectly smooth, round ball of dough. Gently squeeze the ball to form the loaf with a slight pulling motion to form a small loaf. Put in pan and let rise until it has doubled.

Cook at 350 degrees F for about 30-40 minutes in a regular oven until it looks done. When using the Sun Oven it takes a little longer, usually about 50-55 minutes. Let it cook until the bread is golden brown. Keep in mind that after pre-heating the Sun Oven, when putting in the loaves you let out most of the hot air and it will take a little while to get hot again. This makes the dough rise a little more than in a regular oven.



The Sun Oven keeps the moisture in the bread and other food so everything cooked in it naturally tastes better. Think about it: That wonderful smell you get when cooking bread or anything is actually moisture molecules from the food that is being released into the air. With a solar cooker, the moisture stays in the food, therefore it doesn't dry out as easily, doesn't stick to the pan (no hot spots), and tastes better than any other form of baking.

It all sounds complicated, and at first it kinda is. But ohhhh that taste! Nothing quite like fresh ground whole wheat bread. It tastes even better when piping hot. I can eat 3/4 of a loaf when it is hot.

Two Bakers Secrets

Oh, a baker gave me a secret. He said, don't wash the pans with soap. If you have to, rinse them off with warm water and a little soft brush if needed, but keep the pan cured like a cast iron Dutch oven.

Best to wipe the loaf pans without water, keeping them oily and ready. Using this method I never had a loaf stick to the pan. I clean the pans myself because someone might put them in the dish washer, and that's the worst thing for them.

The baker taught me another secret. He said put the loaves in a plastic bread bag just **before** they get to room temperature, not **AT** room temp. This goes against everything we have been taught. While they

are still a LITTLE warm on the wire bread rack, put them in a bag, seal them and put them in the freezer immediately, all except the ones you are munching on, of course. Don't let warm bread sit in a bag at room temperature as moisture will form in the bag.



Bread in the Villager

This quick freeze method makes for a fresh loaf when you want it for dinner later in the week. Yum



A Solar Cooking Discussion

A few thoughts and tips about using the Global Sun Oven

If you are planning on getting a Sun Oven in the near future here's a few tips that might help you enjoy cooking with sunshine a little more.

I've had a lot of enjoyment during the past 10 years cooking with the Global Sun Oven. We've sold about 250 of the ovens in the last ten years and I've only heard back from a handful of customers so I have to rely upon my own experiences for these thoughts. Unfortunately I have heard of one or two people who bought one but never used it! That's unimaginable to me because, when it comes to cooking, I use my 10 year old Sun Oven for darn near everything (Except BBQ).

The hardest thing to get across to people when they imagine cooking with the sun is that they need to re-think cooking a little. **No more timers, no more thermostats, no special recipes.** You read that right. You learn to cook the food until it is done (or a little more than done).

Quick set-up at home, camping or anywhere

When most people see the Global Sun Oven for the first time they often say, "Oh, that would be good for camping". Probably, but I haven't used it for camping yet. I use it almost every day that I am home when it is sunny outside (a lot of sunny days in Vegas). **I especially like to use it in the summer** because I don't heat up the house and make the air conditioner go into overdrive. Sure we are saving energy, but it is also a comfort thing as well. I keep the oven stored like a suitcase behind the couch then grab it, set it on the patio, open the reflectors, point it in the general direction of the sun and go get the food ready. In about 15-20 minutes the oven is preheated to 375 or 400 degrees F. so I put in the food when I'm ready.



Focusing the reflectors is easy, just center the box in it's shadow, then adjust the height so the oven is 90 degrees to the sun.



Cooking time is a little longer

A commercial solar cooker like the Sun Oven will reach hotter temperatures than a home built solar cooker made out of wood or cardboard so there are **no special recipes** when cooking. Use the same recipes you are used to, but the cooking time may be a little longer. I've found that anything I can cook in a regular oven can be cooked in a Sun Oven. Most foods can be kept hot in the oven for a long period past the point it is cooked.

No special pots needed

I've used every type of pot imaginable, but I have my favorites. I try to use thin, dark metal pans with a lid but I have been known to use a Lodge indoor Dutch oven a few times. More on that later! I do refrain from using shiny mirrored pans as they reflect light (heat) out of the oven. I use regular bread pans that are a little dark, but I have used the throw-away aluminum formed pans with perfect success.



Food is hard to burn

I can't tell you how many times that I've been side-tracked and forgot I was cooking. The food probably was done to perfection an hour ago but I left it cooking longer than necessary. A little browner, but not ruined like the oven or BBQ. The sun moved and the interior cooking area got a few degrees lower temperature, but no ruined food! Because of the forgiving nature of solar cooking, I sometimes call it the "Lazy mans cooker". I've heard a hundred times that I am not alone when it comes to burning the family dinner.

Holds moisture

Please understand that cooking longer at lower temperatures than the recipe calls for is OK in a Sun Oven, but would prove disastrous in your regular electric or gas oven. The reason is moisture. The heating element or burner in an oven will pull out the moisture of the food and send it into the room.

That great smell you get in the room when cooking bread is actually moisture molecules from the bread that is released in the air. This process of exchanging air does not happen with a solar cooker because there is no burner most of the moisture stays in the food so naturally food tastes better and is more nutritious.

Overcast days take longer

I've actually cooked a perfect loaf of browned bread on a slightly overcast day when the oven only got to 250 degrees F. It took three hours but it was perfect. Normally I cook bread during the morning hours when the sun seems to be brighter and the oven on my patio is a little hotter. It usually takes about 55 minutes for two loaves of bread.



Bread

Speaking of baking bread, **there is something magic about cooking bread in a Sun Oven.** I am pretty sure it is the moisture retention. You may find that when baking rising dough's or batters that you will want to put a little less in the pan than what you are used to. Because some of the pre-heat temperature is lowered immediately when opening the glass door to put in the bread, the lower temperatures are not immediately raised as fast as in an oven. This allows the bread to rise a little more before actually baking.

Cakes

This is especially true of cakes. When first using the Sun Oven my cakes overflowed. Messy. So I **use a little less batter in the pan** and the cake turns out light and fluffy every time. I have done pies but I find that lower temps and longer cooking times let the sugar in the filling absorb into the crust so it is not as flaky as it should be.

Cookies

When I said food was hard to burn I did not mean cookies. If the recipe says 10 minutes, you better be ready to take 'em out in 11 or 12 minutes. Cookies do not have enough moisture to withstand longer

Pizza

If you like pizza with the cheese just melted then you better turn on the gas oven. The Sun Oven cooking chamber is small so only a small pizza will fit. When cooking pizza the cheese needs to be burning a little (bubbly and getting dark) so that you can be sure the dough in the center of the pie is cooked.

Rice

Ok, how many of us use our oven to cook rice? We use an electric rice cooker or stove top with a high temp burner so the rice cooks in about 20 minutes. It probably takes about an hour or longer in a regular oven. Rice takes about 1 ½ hours to cook in a Sun Oven. Every time the rice is perfect, light and

fluffy. I was surprised that not one grain of rice sticks to the pan. Food doesn't stick to the pan because there is no burner causing hot spots. Often I cook the rice in the afternoon after the bread and main course is done. I aim the oven west towards the sun, set the adjustable leg to the highest level and forget it. I've often gone out to fetch the rice three hours later and the rice is always perfect.

Vegetables

Usually less water is needed when cooking vegetables but always use a pan with a lid. The sun will discolor the veggies. Casserole dishes with vegetables are ok but pasta dishes will have softer pasta. To get al-dente you may have to use your stove top because boiling water in a Sun Oven is a gentle boil, not a rolling boil.

Chicken, Beef or Pork Roasts

If you are a meat eater then you will enjoy the taste of your roasts far more than if cooked in an oven or crock-pot. I'm serious about that! The only better tasting method might be BBQ, but one could argue that solar is best because the food is healthier and long cooking times will save a bunch of propane or briquettes.

Larger Turkeys, Hams or Roasts

As you can see, the cooking area in a Sun Oven is relatively small. During the first few years I always kept an eye out for special smaller pans, cookie sheets and muffin pans to fit my cooker. Here's a way to cook larger roasts like a 20 pound turkey that will not fit on the small leveling cooking shelf.

First, I take out the leveling shelf (it's easy). Then, I use a Lodge Mfg. 12" indoor Dutch oven. It is **important** to use the **Lodge brand** as the cast iron is **thicker** than foreign import cast iron. I place the indoor Dutch oven (one **without** legs) in the bottom of the Sun Oven and let the oven preheat. It takes 10 or 15 minutes longer to preheat because there is more metal that absorbs available heat.

I place the larger roast in the pan trying to situate it so that the top doesn't hit the glass door when it is closed and latched. I make sure to cook during the middle of the day so that I don't have to tip the oven with the adjustable leg at the back. If the pan is tipped too much you will spill juices all over the place! I've had to cut off the top of a ham to make it fit but I just wedged the piece in the side of the pot to cook.

The only problem (no problem) is that the bottom of the Sun Oven is not a cooking surface even though it is metal. So, cooking in this manner will invariably scratch the black paint and it will start to peel away.

When this happens the interior of the Sun Oven looks tacky and it is said that the oven will not get as hot, though I haven't noticed any real difference.

The reason that you do not want to use a thinner metal pan is because the heat may not transfer to the middle of the pot to cook the food. When food is on the leveling tray then heat surrounds the pot just like in a regular oven. That is why I say only use a thick Lodge brand pot. The thick cast iron transfers heat to the middle of the pan just fine.



Speaking of cast iron, my favorite thing to cook is cornbread. I use the triangle type pan shown and it always turns out yummy with individual

browned pieces. Mix up some cornbread mix, about a half a can of creamed corn, some butter and honey in the batter and mix. Spray the pan with a little cooking spray and its good eatin' in a few minutes.



Winter cooking

Yes, solar cooking works in winter months, even in sub zero climates as long as you have good sunshine. Because the sun is lower on

the horizon the temperatures are not as hot as in the summer. This applies to any solar device as there is less sunshine to use. I've cooked a 22lb turkey using the Dutch oven method for Thanksgiving but usually I don't mind the smell of cooking turkey in the house with the regular oven. Global Sun Ovens are popular at Base camp at MT Everest because they work so well.

When cooking, the glass gets condensate on the underside. This tells you that the food is cooking. This condensate will drip on the wood trim when the door is opened and has a nasty habit of slightly staining the wood frame. I found that painting the wood trim with a couple coats of polyurethane will keep the wood looking nicer, longer. At the factory the wood is treated with a UV inhibitor designed to last 20 or more years of regular use, but I intend to use mine much longer (heaven willing).

Makin' it look like new

When the paint on the bottom of the oven gets too ratty looking I gently take off the reflectors, the glass door, scrape any loose paint off the bottom and paint the inside of the oven with flat black high temperature paint. It looks brand new! Please note that you want to protect the polished aluminum reflectors at all costs. If the wind blows over your cooker the panels will bend. The oven will still work but it may cause burn marks on your bread.



Other Important Uses

I believe that the Sun Oven is one of the most important

emergency preparedness items that you can get for your family. You can find more in other discussion flyers available at the store.



We use the Sun Oven at home, but in the Third World solar cooking is critical, even life saving. One Sun Oven saves up to 4000 lbs of wood a year. Fuelwood is needed by nearly half of the world's population for cooking. Solar cooking helps habitat and helps eliminate many respiratory diseases associated with cooking smoke. It can pasteurize water, impeding diseases like cholera and diarrhea in children. Solar cooking could be instrumental in saving the lives of 15 million children who die every year. Our adventures with solar cooking at home is only the beginning of the importance that solar cooking can provide for the world.

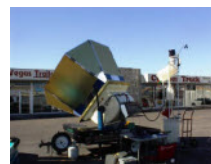
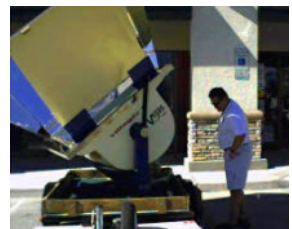


Villager Sun Oven

The world's largest commercial solar cooker will cook 50 loaves of bread at one time, providing hundreds of loaves of bread and other pastries each day for villages that have fuel shortages, or the fuel is intermittent and expensive. 12 to 15 women benefit from good paying jobs in the village bakery using the Villager. It can cook up to 1200 meals a day.



There are 200 of these giant cookers in Third World countries helping small villages maintain a bakery so that they do not have to ship in expensive stale bread from big cities. Most Villagers are donated by groups and clubs. One Villager can save 364,000 pounds of wood a year. The Villager and other solar cookers can make a huge difference in forest habitat and the health of nearby villages. You can help sponsor these life saving solar ovens in many areas of the world.



Vegas Trailer Supply hosted special research to determine how the Villager could help with crop food-drying in Third World Countries.

The Villager Sun Oven, as well as the Global Sun Oven, are playing vital roles in communities throughout the world, especially Third World areas. Please visit <http://sunovens.com> to find out more.



A not-too-technical discussion of solar & RV batteries.

Types of batteries:

The most common type of battery used in small solar systems and RV's is a wet-cell 12 volt "deep cycle" or 6 volt "golf-cart" battery. Typical car or truck engine starting batteries are never used because they are not designed to take the constant charging and discharging cycles. AGM (absorbed glass mat) and gel batteries are also used for special applications and when less maintenance is wanted, but are more expensive and less used than typical deep cycle or golf-cart batteries. Many high end rugged batteries are available that we are not including in this discussion, but their cost is also high end.



6 volt can be better choice.

6 volt golf cart batteries usually outlast deep cycle marine batteries if they are maintained properly. Take a look at the three cells in a six volt battery, and then look at the size of each of the six cells in a 12 volt battery. Which one is larger? The individual cell on the six volt battery is larger, and thus has heavier duty lead plates in it.

Deep-cycle: bad name if you ask me.

Deep cycle batteries should not have been given the name "deep cycle" because many people mistakenly think that they can regularly "deep discharge" their batteries until the lights go dim. Yes, deep-cycle batteries will take a deeper depth of discharge than a typical car battery, but they will undergo damage or dramatically shorter life if constantly discharged too much. Usually the battery bank is 90% discharged when the incandescent lights start to dim and that's way to low. If you regularly discharge your battery that low then you are doing irreparable harm to your batteries.

What state of charge are my batteries?

It is my experience in the solar and RV business for 25 years that most RV owners have no idea how far they can discharge a battery (bank) safely. When someone comes into the store and says to me "Mike, I am having battery problems." I give them my little one-hour battery condition chart then ask "What is your battery voltage?" Often I get answers such as "12 volts, it's a 12 volt battery isn't it?" I then show them that 12 volts on a 12 volt battery is nearly at 100% discharge. Or, I get an answer to my question like, "13.2 volts". I say "do you see anywhere on that chart where 13.2 volts is listed?" No, you will not find it listed. The higher reading was a result of the customer not waiting an hour for the surface charge to dissipate.

One Hour Battery Condition Chart

Is your battery full when it measures 12 volts? What state of charge is your battery bank when it measures 13.4 volts immediately after a charging cycle? Use this handy chart to monitor your battery condition.

Specific Gravity	Voltmeter Reading	State of Charge
1.270	12.7	100%
1.250	12.5	75%
1.190	12.3	50%
1.150	12.1	25%
1.120	11.8	Discharged

Please save this chart. You will need it to monitor your battery condition. Take readings **1 hour after sunset or any charge cycle.** False readings (surface charge) will occur before this. Use digital meter only (not analog). Check battery fluid frequently. Do hydrometer readings once a month and when abnormalities noticed. Slight variations occur at extreme hot or cold temperatures.

CAUTION: Wear safety goggles and other protective gear when servicing batteries. Be careful around batteries, serious injuries can result. Keep a box of baking soda nearby. Batteries must be properly stored and vented to the outside of structure. Explosive gas rises off all wet-cell batteries when charging. Never allow battery terminals to be shorted out. This can cause serious explosions and fire.

It is quite possible for a battery that is completely discharged to receive a 10 minute charge and then read 13.2 volts immediately after stopping the charger. When an hour has passed from any charging cycle, you will get a more accurate idea of the state of charge in your battery bank.

Use a digital volt meter.

When taking readings, please use a digital volt meter instead of an old type analog meter. It is okay to have an inexpensive digital meter purchased from your local discount store, but I advise a \$20 - \$40 dollar hand held volt meter for longer life and a bit more accurate readings.

Never discharge more than 50%

I tell my customers to never let their battery bank get below 50% discharged on a regular basis. Of course, in an emergency, you can use that remaining 50%, as long as it is not done frequently. Most people say they don't have any idea when their batteries are 50% discharged. I then give them my chart. Batteries that are watched and not "deeply discharged" will last twice as long as other batteries. Those that remain consistently in the 70 to 80% full zone will have even longer life.

6 volt batteries are taller.

Batteries like to be discharged slowly and charged slowly as well. The size of your battery bank in relation to the charge/discharge rates can be an important factor. As a general rule, more batteries are better than less, but many RV's don't have room for more. When changing from 12 volt group 24 or group 27 batteries to heavier duty 6 volt golf-cart batteries, you have to consider that the 6 volt ones are usually an inch taller. Often there is not enough room in the compartment for the switchover.

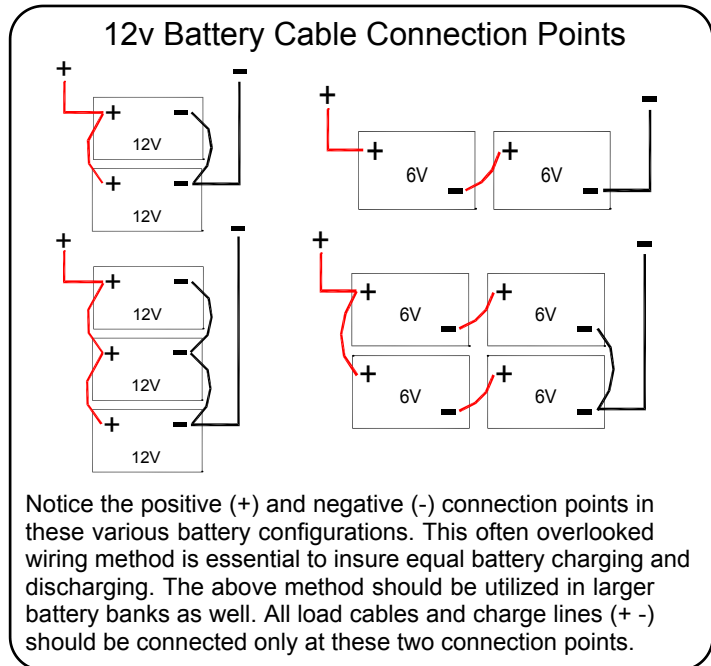
Keep 'em together.

When expanding to more batteries, you need to keep them close together. It is not a good idea to have three batteries in one compartment and another battery in an area 5 feet away. There are losses in the longer cable and it is not a good mix to have batteries separated.

Connection point for positive (+) and negative (-) cables.

This brings up another problem we often see in wiring the battery bank. Take a look at the diagrams to the right and you will see that each bank of batteries has the negative (-) charge/load connection on one end and the positive (+) on the other end. This is important for the life of your batteries and many, many dealers, even coach manufacturers don't follow this important wiring rule.

You see, if both the negative and positive connections are made on one 12 volt battery at the end of a line, then the closest battery will work hardest and the others will work less. This is due to the resistance in the big cables and electricity takes the avenue of least resistance, just like running water flowing down a hill. The end result is that the harder working battery will have a shorter life and the other lazy batteries will have a shorter life too, because they are all connected together. It is best to charge and discharge all of the batteries in the bank equally by wiring them correctly.



How many batteries are best for my solar system?

When sizing a typical RV solar system I generally tell people to try to have one battery for every 40 to 60 watts of solar panels. This is a good rule of thumb. It is better to go a little more rather than less if there is a choice. Sometimes there is no choice due to space limitations so you just go with what you can. I have seen too many batteries for existing solar panels however. One fellow had 8 large batteries hooked up to one 60 watt solar panel. He had no daily power to use because some batteries loose up to 1% a day just sitting there. His panel barely kept up with the natural daily loss of his battery bank.

How many solar modules should I buy?

When trying to determine how many solar panels (modules) a customer should buy I try to evaluate their needs by adding their expected loads but the fact of the matter is everybody's needs are different and often can't be exactly determined. Sure you can use a load evaluation form and make an educated guess, but most of my customers start smaller with the anticipation of expanding their system later. Often the higher cost of a completely independent solar system is an important factor. Well, you can start smaller and expand later but I would install a larger controller and larger wires than what is currently needed so that expanding is much easier and less costly later.

Compartments;

Just about any type of battery compartment will do, but the compartment should be sealed from the inside living quarters and the battery compartment should be vented to the outside to let explosive hydrogen gases escape. We've seen batteries installed in the cabinet under the sink. Not a good idea. We have several choices of battery storage devices, but when considering location please keep in mind that extreme heat or cold can severely limit the life of a battery so a little insulation can go a long way.



Charging:

Typically RV batteries are charged in many different ways, but primarily through the converter when plugged into shore power or a gas generator. There are good converters and then there are bad ones, unfortunately most of the older converters are bad ones. Often older converters will over charge batteries when the rig is plugged into 110vac power for longer than a couple of days. This situation can be remedied by changing the converter to a completely automatic newer one.

Inverter/Charger:

If you are in the market for an inverter that supplies 110vac from your 12 volt batteries then you may want to get rid of the old converter altogether and use a good inverter/ charger like the Xantrex Freedom 458 series inverter. This type of inverter completely replaces the converter because when powered by 110vac it supplies enough 12 volts dc to run the entire coach as well as charge the batteries with the good 3-way charging method.

Bad Converter/chargers

I know this is a lot to absorb, but you'll get it. Older RV converter/chargers provide enough dc power to run your home-on-wheels but usually only provide a 5 amp charge to the batteries. A charge rate of 5 amps per hour takes a long time to get the batteries full if they are low and this constant 5 amp charge is bad for the batteries if they are full. Hey, if your two 100 amp batteries are 50% discharged it will take you 20 hours of running the generator to get them full again! If kept connected to the batteries after they are full you run the risk of drying up the electrolyte in the batteries. Almost every day I hear of batteries that went dry after several weeks of being plugged into shore power because the batteries were charging too long at an improper rate. I recommend to my customers that they disconnect their batteries after a couple of days of being plugged into shore power. Five amps per hour is too low for a "bulk" rate when batteries are low, and too high for a "trickle" charge rate. A 3-way charge system is the best way to go.

3-way charging.

A 3-way charging system does several things to extend the life of your batteries. First, if the batteries are low then the charger charges at a higher rate to get the batteries full. Typically the Freedom series inverter charges at a rate of 100 amps to get the batteries in the "safe zone" quickly. This high rate diminishes as the batteries get close to full. When the voltage of the batteries gets close to a full state of charge then the charger switches to "absorption" mode. This means the voltage remains at a set point that charges the batteries at a much slower rate, similar to a "trickle" charger. After the batteries show full then the charging system switches to "float" rate which is electronically controlled to give the batteries just the right "top-off" zaps to further lengthen the life

and storage capacity of the battery bank. There's more to it than that, but you get the idea: charge quicker when needed and no overcharging.

Solar is good.

By their nature, solar modules provide a fairly low rate of constant charge and most solar controllers provide batteries the "good" charge cycle similar to a 3-way system.

Am I supposed to be a battery expert?

Well, not exactly, but if you want your batteries to last longer or you are dependent on them for your power while you are out "boon-docking" then you will probably need to learn more. It may seem like a lot to learn but there's actually more you should do to optimize the life of wet cell batteries. This chart is a quick review with some do's and don'ts, but you may still have a few questions after reading it.

More FAQ's

Why can't I replace one new battery in my older battery bank? Older batteries will make a new addition old too. All batteries in a bank should be replaced at the same time. I usually tell people if the old ones are only a few months old it is OK to add new batteries.

What is the proper level for battery fluid at different states of charge? A discharged battery should have the electrolyte level just above the plates. The fluid in a battery expands as it gets charged and if overfilled there is danger of overflow which will change the electrolyte composition and cause irreparable damage greatly shortening the life of the battery. A fully charged battery should have the fluid level just below the dip tube at the top of the cell.

How do I moderate my batteries temperature?

Temperature extremes are bad for batteries, especially heat. Care should be taken not to let batteries sit in the hot sun or get too hot in an enclosed compartment. Insulation may help, as well as ventilation, but sometimes it takes some creative ideas to moderate temperatures.

What voltage adjustments should be made in extreme weather conditions? Many solar controllers and inverter/chargers have a battery temperature sensor which will help regulate the voltage being sent to the battery bank. Batteries should be charged at slightly different voltages in the cold or in hot climates. Chargers with temperature sensors will automatically adjust the voltage but if you plan on taking a trip to Alaska after spending time in the Mojave Desert, then you will want to consult your controller operating manual for manual setting changes.

Do I have the same amount of power (amp-hours) to use during cold weather and warm weather? No. Up to 40% of your stored amps are

lost in cold climates. This should be taken into consideration when using your batteries in winter months. Our customers with solar power not only have less power stored in their batteries, they have less power flowing from their solar panels in winter months because the sun is lower on the horizon.

What does equalize batteries mean and how do I do it?

The Equalizing battery charging cycle is used when the electrolyte has different readings in the cells of a battery. It is a cycle which applies a higher than normal voltage for controlled periods of time when needed. Great care must be used when using this cycle because excessive explosive gasses are formed. Sometimes a battery can get hot and the cycle must be stopped. Many inverterchargers have this manual feature and all safety precautions must be taken. Special precautions must be observed when equalizing wet cell (flooded) batteries. Thoroughly read and understand your instruction manual before performing an equalizing cycle.

How often should I equalize my batteries? I have heard monthly, every other month, yearly, etc. After the battery bank has been fully charged Trojan Battery says that when the electrolyte reading in a battery is low or wide ranging (+/- .015) between cells, and after being fully charged, is the time an equalization cycle should be performed. The electrolyte level is measured with a hydrometer.

What does de-sulfation mean and how do I de-sulfate my batteries? Basically all batteries collect sulfates on the metal plates during their life. Older or heavier use batteries will have more than newer batteries. Some newer automatic battery chargers have a de-sulfation cycle where a voltage is applied in rapid pulses thereby loosening buildup which falls to the bottom of the battery or re-mixes with the solution. Typically solar controllers, inverters and battery chargers do not have this feature. The equalizing cycle uses a different method (higher voltage) to accomplish de-sulfation.

Do I really need a hydrometer? Best get one and learn to use it. It will give you another level of understanding your batteries. Voltmeters are a help in knowing what is going on with your batteries, but they do not tell the whole story.

Should I stick to distilled water to fill my battery fluid? I think all battery manufactures suggest distilled or de-mineralized water for filling battery cells. I have been told that in a pinch it is better to put a good filtered (no minerals added) bottled drinking water in the cell rather than let it go dry.

I've heard that a battery will go dead or rapidly discharge if left on the floor of my garage. This is an old-wives-tale. It used to be true when battery cases were made out of bakelite. They would slowly discharge to ground when placed on a cement floor.

Modern battery cases are made out of plastic materials which do not conduct electricity so there is no capacity loss when placed on the ground. Actually, in hotter climates like here in Las Vegas, it probably is better if the battery were placed on the cooler cement floor during warm weather. It is recommended that the battery be placed on a mat or catch basin so that any spilled or leaking acid is contained.

I've heard that batteries are dangerous. What precautions should I take? Batteries are very dangerous and a healthy respect for safety precautions must be vigilantly observed.

What are the fuses and breakers for? Where should they be in relation to the battery? Okay, if you are asking this question then you may need a professional do your wiring. All wires or cables (circuits) must be fused for the wire size and expected amp (current) draw. This goes for 110vac in your house and 12vdc in vehicles. All wires will melt if too much current flows through them. The fuse or breaker must be placed as close to the battery bank as possible. Often a fuse block is used with a larger positive feed wire coming from the battery. In addition to each small branch wire having a fuse, the large feed wire must be properly fused close to the battery. If it's attached to the battery it better be fused properly!

I want to run a small inverter off my cigarette lighter plug. Can I do this? Well, you can try. If the inverter is a small one (50 to 350 watts) then you probably are okay. I have found that the guy who wired the cigarette lighter didn't think about the huge current draw of inverters so he put in too small of a wire. Most inverters should be connected to the positive (+) and negative (-) terminals of the battery bank directly with proper connectors and fuses inline. Most inverters instruction manuals will tell you wire sizes and maximum length allowed. Please follow these instructions carefully. Try to go less than maximum allowed on distance from battery to inverter if at all possible.

I want to run a larger inverter through my cigarette lighter plug. Is this possible? Heck no. The same goes for large inverters (above 350 watts) as small ones. Make sure you have the correct size wire, connectors, disconnect, fuse (or breaker), and keep the distance from battery to inverter at an absolute minimum. It is very important to follow the manufacture instructions for these parameters. You can go with larger size wire if needed and you will need a recommended "disaster fuse" on the positive cable connecting to the battery. Most large inverters do not come with a proper fuse in the box when making a purchase. If you do not know what size to use, contact us for suggested specs. We carry several options when it comes to larger amp draw fuses and disconnects.

Where do I find out more about battery care and maintenance? We generally keep a supply of a brochure 'Deep Cycle Battery Maintenance' (Expanded Edition) that is distributed by the Trojan Battery Company. Stop by Vegas Trailer Supply to pick one up for your library. You can find great info and videos at the Trojan Battery web site: www.trojanbattery.com. Look under Tech Support or Battery Maintenance.

For the "cup is half empty" folks:

Eleven Sure ways of shortening the life of deep cycle wet-cell batteries;

1. Frequent discharge below 50%.
2. Over charging.
3. Combining new batteries with old.
4. Connecting load or charging lines in the wrong place in a bank.
5. Charging too fast or too slow.
6. Letting electrolyte fall below top of plates.
7. Overfilling cells.
8. Extreme heat or cold.
9. Charging at the same voltage/rate when hot or cold.
10. Never equalizing batteries.
11. Let sulfate build up on plates.

For the "cup is half full" folks:

Eleven Sure ways of lengthening the life of deep cycle wet-cell batteries

1. Always keep batteries above 50% full, preferably 70-80% full.
2. Use "automatic" battery chargers or 3-way inverter/converter chargers.
3. Replace entire battery bank at same time.
4. Connect load/charge lines so all batteries charge/discharge equally.
5. Use 3-way (bulk, absorption, float) chargers/inverters or solar controllers.
6. Keep fluid above plates (just below bottom of fill tube when fully charged).
7. Learn where fluid level should be at discharged state and full state.
8. Moderate extreme temperatures.
9. Keep cold batteries fully charged, adjust rate for extreme temps.
10. Equalize bank when needed.
11. Perform periodic de-sulfation cycles on older or hard working batteries.

Additional information can be found through the solar living pages at www.vegastrailer.com and www.solarforemergencies.com



Small Wind Power

When dealing with using solar for emergencies, I often overlook the power of wind. A wind generator is also a form of solar energy, because the sun is directly responsible for wind generation. Actually you could say that the sun is the source for all energy, including coal, oil and wood fuel.



The newest generation of wind generators is the Air Breeze that produces 200 watts at 28 mph. At first glance it seems that this version will produce half of the Air-X, but the blades have been totally re-designed and it starts to produce power at lower wind speeds, with a net effect of more power to the user.

Wind generators are a great compliment to solar systems if a large enough battery bank is used. They have a built-in battery regulator and braking system for high winds. Here's some Air Breeze info;



Actually wind generation of power is the least expensive of all forms of electrical generation, if you have wind. On the other hand, solar photovoltaic electrical generation is the most expensive. Of course all

formulas change if you do not have power at a remote site, or the electrical grid is down.

For years we have been selling the small Air 303, Air 403 and lately the versatile Air-X wind generator. These units produce 400 watts of DC power when the wind is blowing 28 miles per hour. Typically wind is profitable when the wind averages at least 12 mph.

Wind generators need to be erected on tall poles, the higher the better. Most urban areas do not allow wind generators to be erected on towers in the city but they are popular in rural areas. They do attract attention, but they are usually mounted so high that the bad guys can't get to them.



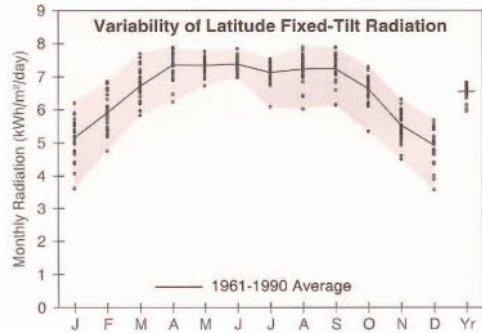
The new Air Breeze is quieter and more efficient at lower wind speeds than other small wind generators. It is built with rugged composite blades with Aircraft-quality aluminum alloy castings and a brush-less neodymium alternator. The Air Breeze is maintenance-free with only two moving parts.




Portable RV Mount

Solar Radiation for Las Vegas, Nevada

The information on this page will help you see the variable amount of solar energy (radiation) that hits the earth throughout the year. This information was taken from the National Renewable Energy Labs (NREL) WBAN # 23169 documentation. The top graph shows the monthly variable energy for all fixed tilt mounted panels (no tracking device). This means any solar collector (panel) that is permanently mounted flat, like on an RV or tilted at various angles, like on a house.



As you can see there is slightly more efficiency when changing the tilt angle of the PV panel during the year. It may not be worth the effort or expense in adjusting your solar array racking. If you have a cabin and mounted the panels permanently at 36 degrees tilt you would get 6.5 average sun-hour days throughout the year. Flat on a roof will average 5.7 hours. Changing the tilt two times from 21 degrees to 51 degrees will avg. 6.84 hours and changing the tilt 8 times a year (51,21,0,21) will net 6.88 avg. sun hours per day. All figures are for Las Vegas, NV and are based upon facing the solar array due south, not magnetic south.

The figures in the columns on the second chart below represent full sun hours. The mathematical figure represents the industry standard for a full sun hour (based on 1000 watts per square meter) that all solar panels use for rating their size in watts.

Other WBAN charts for other parts of the country are available through links at vegastrailer.com or solarprepared.com.

The typical way to mount solar collectors on an RV is flat on the roof so the pertinent information is the "0" row on the second chart. As you can see in the last column of the second chart, the amount of energy gained by tilting is only around 11%. This amount of gain usually does not justify the extra expense and trouble for an adjustable RV mount.

The Third chart gives related climate information. This information is included because of the nature of solar panels creating less voltage when hot and more voltage when cold. The wind speed average figures are given in meters a second (1 meter a second = 3.281 feet per second). Thus the average yearly wind speed in Las Vegas is 14.43 feet per second, or 9.84 miles per hour (4.4 x 2.2369).

0 = 0 degrees flat on (RV) roof
 Latitude - 15 = 21 degree tilt
 Latitude = 36 degree tilt
 Latitude + 15 = 51 degree tilt
 90 = Vertically on South facing Wall

Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty +9%

Degree Tilt		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0 (Flat Roof)	Average	3.0	4.0	5.4	6.9	7.8	8.4	7.9	7.2	6.2	4.7	3.4	2.8	5.7
	Min/Max	2.3/3.4	3.4/4.5	4.8/6.1	6.1/7.4	7.2/8.3	7.8/8.9	6.6/8.4	6.0/7.8	5.4/6.7	4.0/5.1	3.0/3.7	2.2/3.1	5.3/5.8
Latitude -15	Average	4.4	5.3	6.4	7.5	7.8	8.1	7.7	7.5	7.1	6.1	4.8	4.2	6.4
	Min/Max	3.2/5.3	4.4/6.1	5.6/7.3	6.4/8.0	7.2/8.3	7.6/8.6	6.5/8.2	6.2/8.2	6.1/7.7	5.0/6.7	4.0/5.4	3.1/4.8	5.9/6.7
Latitude	Average	5.1	5.9	6.7	7.4	7.3	7.4	7.1	7.2	7.2	6.6	5.5	4.9	6.5
	Min/Max	3.6/6.2	4.8/6.8	5.8/7.7	6.2/7.9	6.7/7.8	7.0/7.8	6.1/7.5	6.0/7.9	6.1/7.9	5.3/7.3	4.5/6.3	3.6/5.7	5.9/6.8
Latitude +15	Average	5.6	6.1	6.6	6.8	6.5	6.3	6.2	6.5	7.0	6.8	5.9	5.4	6.3
	Min/Max	3.8/6.8	4.9/7.2	5.7/7.6	5.7/7.3	5.9/6.8	6.0/6.7	5.3/6.5	5.5/7.2	5.9/7.6	5.4/7.5	4.7/6.8	3.8/6.2	5.7/6.6
90 (Wall)	Average	5.0	5.1	4.7	3.9	3.0	2.6	2.6	3.4	4.5	5.3	5.2	5.0	4.2
	Min/Max	3.4/6.2	4.0/6.0	4.0/5.4	3.3/4.1	2.8/3.1	2.4/2.7	2.4/2.7	2.9/3.7	3.8/4.9	4.2/5.9	4.1/6.1	3.5/5.8	3.7/4.5

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	7.5	10.6	13.5	17.8	23.3	29.4	32.8	31.5	26.9	20.2	12.8	7.6	19.5
Daily Minimum Temp	0.9	3.8	6.6	10.4	15.7	20.8	24.6	23.4	19.0	12.4	5.9	1.1	12.1
Daily Maximum Temp	14.1	17.4	20.4	25.3	31.0	37.9	41.1	39.6	34.8	27.8	19.7	14.2	26.9
Record Minimum Temp	-13.3	-8.9	-5.0	-0.6	4.4	9.4	15.6	13.3	7.8	-3.3	-6.1	-11.7	-13.3
Record Maximum Temp	25.0	30.6	32.8	37.2	42.8	46.1	46.7	46.7	45.0	39.4	30.6	25.0	46.7
HDD, Base 18.3°C	336	216	162	79	8	0	0	0	0	34	169	332	1337
CDD, Base 18.3°C	0	0	12	64	163	332	449	408	258	91	0	0	1778
Relative Humidity (%)	45	40	33	25	21	16	21	26	25	29	37	45	30
Wind Speed (m/s)	3.6	4.1	4.9	5.1	5.2	5.1	4.9	4.5	4.3	3.8	3.8	3.4	4.4