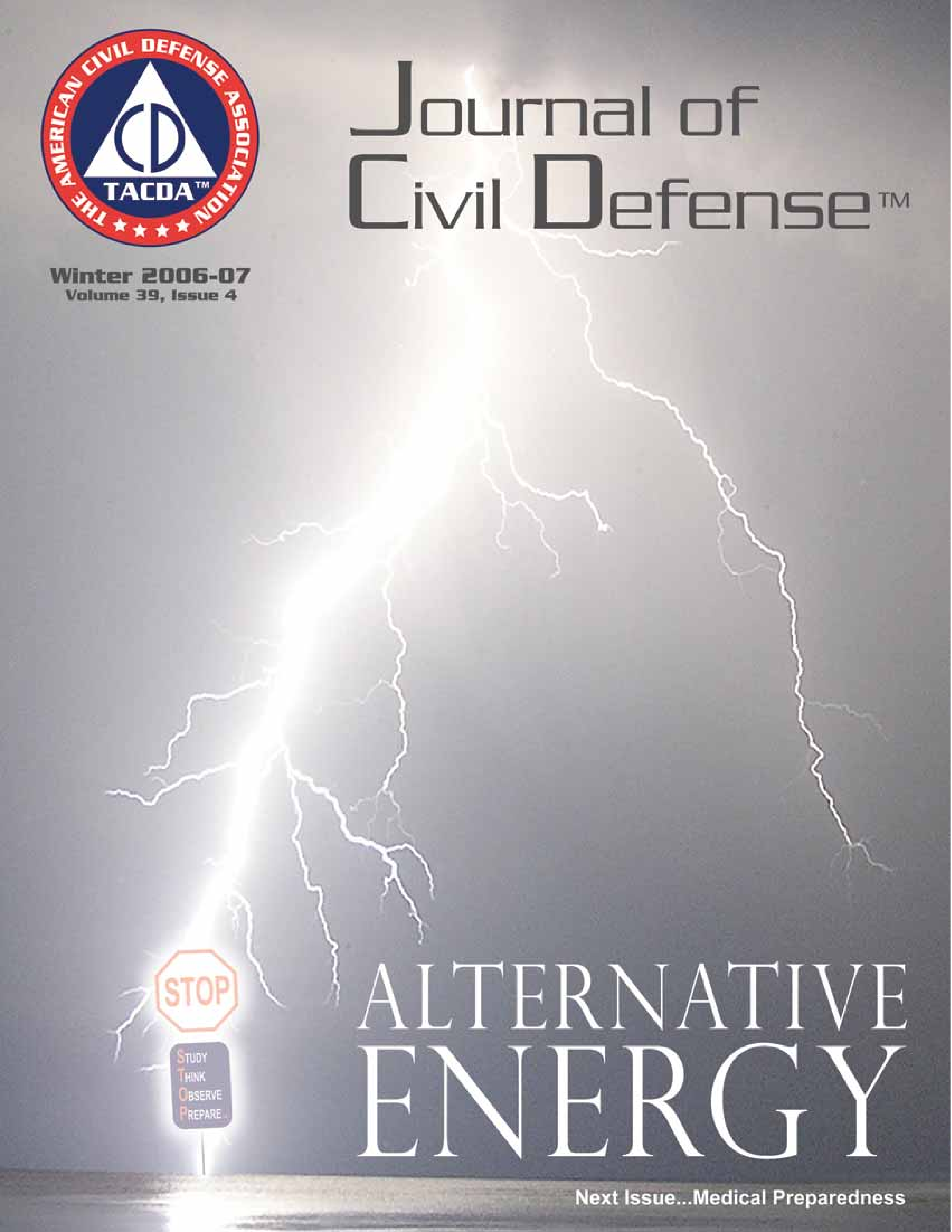
THE AMERICAN CIVIL DEFENSE ASSOCIATION
TACDA™

Journal of Civil Defense™

Winter 2006-07
Volume 39, Issue 4



ALTERNATIVE ENERGY

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Journal of Civil Defense™

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ALTERNATIVE ENERGY

Next Issue...Medical Preparedness

Message From The President

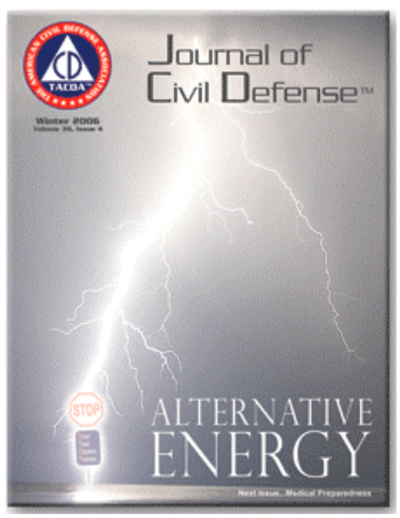
Dear TACDA Members,

Our organization has made some great progress this last quarter, and we currently have sixteen TACDA Academy preparedness lessons posted on the website. All of the material is available to our contributing members and the information can be downloaded and printed or copied to a file on your computers for easy reference. I encourage everyone to study the lessons so that you will be able to respond effectively to disaster situations. The lessons are a very thorough treatment to the represented subjects but I do not believe we will ever consider them entirely compete. We will continue to add new information and revise the existing text to ensure that they provide the best information available at the time.

We welcome comments and suggestions from our membership regarding the new lessons, the JCD, The website, or any other aspect of the organization. Ideas and suggestions from the membership have been and will continue to be the most effective way to improve TACDA.

Now that the TACDA Academy preparedness lessons are available it is time to spread the word to those that are unaware of the tremendous resources available through TACDA. Please encourage anyone who might be interested to take advantage of this new source of information as well as the resources already available through TACDA to help them in their disaster preparations.

I wear an "ARE YOU READY" badge that I received form my local emergency management agency when I leave my home and it is surprising how many questions I receive and how many opportunities that I have to tell others about TACDA. Many people ask about the badge and I have a great opportunity to explain all about TACDA helping them "get ready". I'm not suggesting that everyone wear such a badge but I'm sure that we meet people almost everyday in the course of our normal activities that would be very interested in learning about TACDA. Don't be shy, spread the word!



This issue of the JCD covers alternative energy. We have tried to present some simple and practical methods of addressing basic needs for lighting, communication, and cooking during disaster situations. We always strive to find the low cost effective means that will be useful to anyone. Most problems can be addressed if you have significant financial resources, but the very affordable solutions that are still very effective are really exciting. TACDA always tries to meet low cost and highly effective solutions criteria. We realize we also need to keep the solutions simple but sometimes when dealing with electrical equipment the information may appear somewhat complex. I'm sure that with a reasonable amount of study along with a positive attitude that nearly everyone will be able to understand and use this material. If you do run into some problems please ask us or some other competent individual. Don't allow a lack of understanding keep yourself from adequate preparedness for your and your family. Again, if you have problems, questions, or any other feedback, please let us know.

The next few issues of the JCD are going to cover medical preparations, water storage and purification, and cold weather survival. We welcome any ideas or article submissions you may have on these subjects. Please forward any information you have to jcd@tacda.org.

I would like to encourage everyone to be diligent in pursuing their own disaster preparations. Our worst enemy in most cases in not a lack of information or resources but a lack of action. We must not procrastinate. Get prepared and stay prepared and your and your families will be much more at ease in our troubled world.

Sincerely,

Jay Whimpey, PE
TACDA President

Dear JCD Readers,

It is my wish for a safe and prosperous 2007 to each and every one of you.

Each new year is a chance to reflect on our accomplishments in the previous year and to establish new goals for the upcoming one.

I receive emails and phone calls on a regular basis from concerned citizens asking how they can help and be more prepared. I would like to offer some suggestions that will benefit you, as well as your communities and families.

I cannot stress enough how important it is for each of us to observe our great nation on a regular basis. Watch the local, national, and world news. Read the paper. Sign up for news and newsletter emails to be informed of events that interest you. And when you do come across something interesting, please forward it on to TACDA. We want to hear from you.

Since the first issue of the Journal of Civil Defense was released in the spring of 1968, TACDA has covered a wide variety of topics. Recently, we have been focusing on topics also covered in the TACDA Academy to help emphasize the importance of preparedness issues like:

- **Psychology of Civil Defense**
- **Nuclear Weapons Effects**
- **All Hazard Sheltering**
- **Chemical/Biological Warfare**
- **EMP & Power Failure**
- **Radiation**
- **Natural Disasters**
- **Food Storage**
- **Water Purification**
- **Sanitation**
- **Cold Weather Survival**
- **Evacuation & 72-Hour Kits**
- **Communication**
- **Alternative Energy & Fuel**
- **Medical Preparedness**
- **Post Event Survival**

Preparedness itself is nothing new, of course. And there are many resources out there that provide information to help prepare for emergencies and disasters. TACDA will always be researching the vast information available and provide the means to effectively bring this essential information into your homes. The TACDA website, the Journal of Civil Defense, and the TACDA Academy are just a start. Look for updates to the Resources and Links and "RADIO" Active areas of our website and Journal in 2007.

What makes TACDA such a strong organization, one that has survived for over 40 years, is the commitment of our staff, our Board of directors, and, most importantly, our members and volunteers to educate and learn about preparedness. TACDA will always thrive on this collective commitment with the input of each and every one of us. Presidents and have responded to our letters. Scientists, engineers, military and political officials have contributed to TACDA and have served on our Board of Directors. Everyone working with TACDA knows the value of listening to and informing the American public of ways to educate and prepare for emergencies and disasters.

TACDA needs to hear from you to continue to serve you.

As our current President, Jay Whimpey, stated, "We welcome comments and suggestions…" We always have and we always will. Call, write, email, or fax us and we will respond.

We take your input very seriously because without it, The American Civil Defense Association would not exist.

Thank you for supporting TACDA.

Trey Edwards
Journal of Civil Defense Editor

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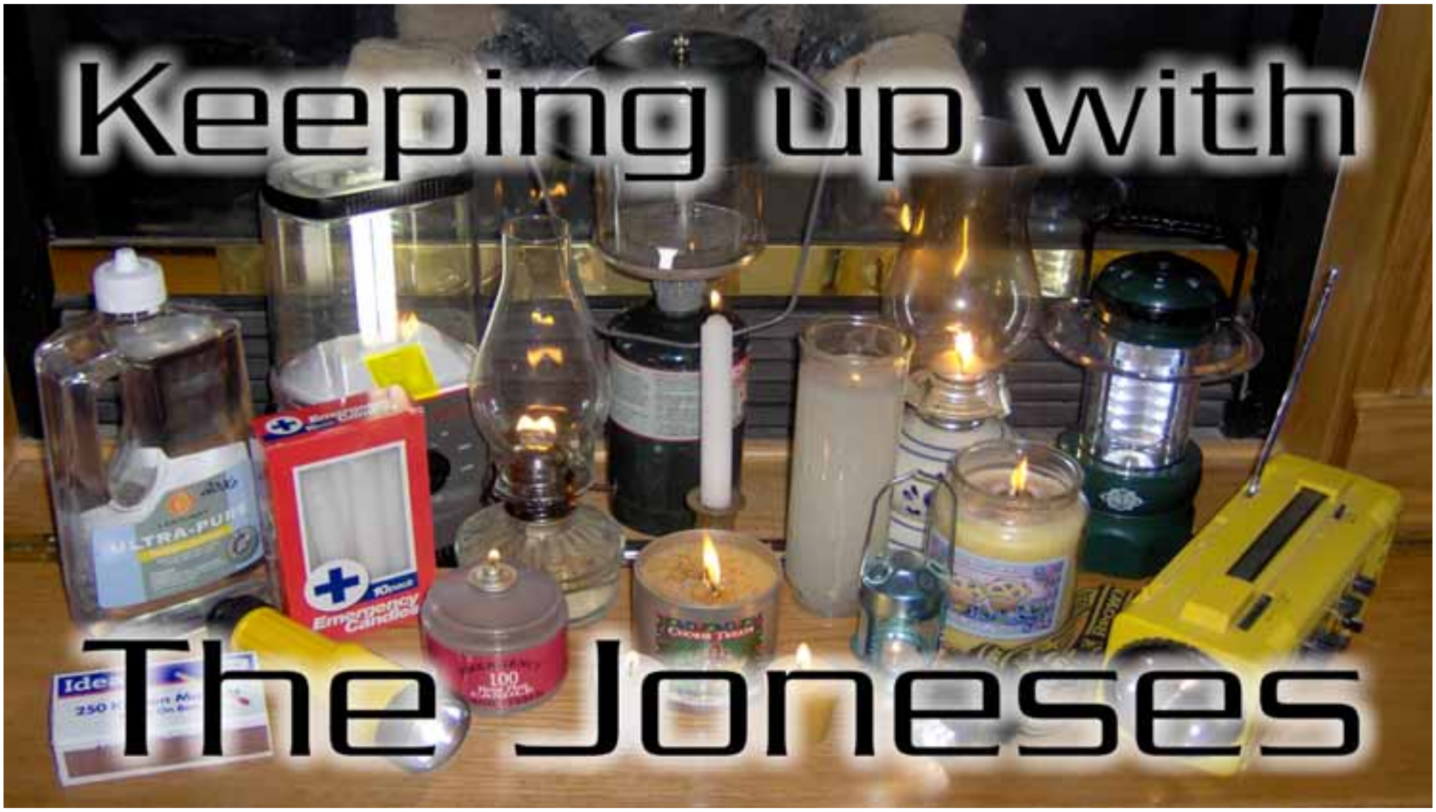

The Power Is Out – It's Getting Dark and I'm Hungry!

By Jonathan B. & Kylene Anne Jones

It's five o'clock on a winter afternoon. Without notice you lose electricity to your home. It doesn't take very long before you realize that you have an immediate need for light and the ability to cook food. It may only last a few hours; but what if it should last for days, weeks, or longer? What would you do? Are you ready?

This article will focus on alternative energy solutions for cooking and lighting. It is important to have a "system of redundancy" (series of options) so that no matter what the scenario you will be able to take care of yourself and your family. For instance, if you are living in a shelter, you will need a different set of options than if you have the ability to cook outdoors.

There is wisdom in storing enough fuel to last for a year. Can we realistically store a year supply of fuel safely and cost effectively? Absolutely! The solution lies in alternative forms of energy and conservation of resources. Allow us to share some of our ideas with you.

Lighting

Flashlights - When the lights go out the first thought is to reach for a good flashlight with fresh batteries. They provide a quick, reliable source of light and are available in a wide variety of shapes and sizes. LED headlamps take very little energy and are nice because they leave your hands free to work. Alkaline batteries are best stored in an airtight container in a cool location. They have a shelf life of three to five years. If stored correctly, they will last much longer than the expiration date printed on the package.

We like our rechargeable flashlight/automatic night light combination. It plugs into the wall and functions as a nightlight; but when the power goes out, it is a fully charged flashlight that automatically turns on. It is easy to find and always ready in an emergency. No-Battery flash-lights with LED bulbs are also a good option. There are a wide variety available; some you shake or squeeze, others you turn a little crank, some are powered by solar energy. Make sure that you buy quality items. The cheap ones may break easily and would be of no value in an emergency.

Candles - There are many different forms of candles available. Candles provide a soft, low light and burn for a long period of time. Candles are easy to obtain and to store. The open flame presents a fire hazard and

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does consume a small amount of oxygen, so use with care. One type of emergency candle comes with a plastic base that is filled with liquid paraffin. It is smokeless, odorless, and has no hot wax to make a mess. It may last for over 100 hours. Candles have an indefinite shelf life.

Cyalume Light Stick – A plastic stick about four to six inches in length that has a glass tube inside. To activate the stick, you bend it (breaking the glass stick inside), and shake it to mix the chemicals. Depending on the brand, it will provide a bright colored light for 6-12 hours. It is windproof, weatherproof, does not create sparks for flames, and is safe for all ages. It may be purchased at most sporting goods stores. It has a shelf life of up to four years. These are the safest form of indoor lighting in case of an earthquake or other situations where flammable gasses may exist.

Electric Lanterns – These are nice for general lighting. They are available with florescent or LED bulbs which make the batteries last much longer. There is also a battery-less hand crank model available with LED bulbs that claims to last for 20 minutes after 60 seconds of cranking.

Kerosene lanterns - A kerosene lantern with a one inch wick will burn approximately 45 hours per quart of kerosene. A kerosene lantern uses one-fourth as much fuel as a gas lantern. The light is comparable to a 40W-60W light bulb. Kerosene is less expensive than many other fuels and, with a little ventilation, can be safely used indoors. It has a long shelf life and is not as volitile as gasoline and Coleman fuel. It will, however, act as an accelerant in a fire and should be stored carefully. Store kerosene in plastic containers as it will rust through metal containers and leak. Kerosene does produce some black smoke when burning.

Liquid Paraffin – Great for use in liquid lamps. It is smokeless, odorless, cleaner than kerosene, and slow burning. It can be used in traditional oil lamps and wick oil candles. The flame should be restricted to one-half inch for safety purposes. Liquid Paraffin is fairly safe and has a long storage life. One quart will provide roughly 200 hours of candlelight.

Solar Powered Lantern – There are a few different solar powered lanterns available. Some may be charged with 24-30 hours bright sunlight, an auto adapter, or a UL listed house adapter. Each model is just a little bit different. A full charge may supply up to 3 hours on high depending on the model.

Two-Mantle Gas Lanterns - These are available in propane or "Coleman" type fuel. This is a good old camping favorite. The light is adjustable, gives off heat, and needs ventilation. White gasoline or Coleman fuel produces carbon monoxide and should never be used inside. Burn time for 1.26 pints of fuel is approximately 14 hours on low and seven hours on high. Coleman fuel stored in an unopened container in a dry place with a stable temperature has a shelf life of five to seven years. An opened container in the same area should be used within one to two years. Use caution when storing the fuel and using the lantern. Do not use indoors.

Cooking

When cooking in an emergency situation it is vitally important to use your fuel wisely. Develop a strategy that will ensure that you are able to cook in several different types of emergency situations including evacuation, indoor, outdoor, sheltered, flameless, etc.

Alcohol Stove – There are many homemade varieties of alcohol stoves, as well as commercial alcohol stoves, available. They are usually small and frequently used by backpackers. Alcohol (in its pure forms) may be used indoors because it burns clean, and it does not burn as hot as other fuels. However, use caution as any fuel consumes oxygen and gives off carbon-dioxide as it burns and therefor adequate ventilation is required. Denatured alcohol is a good alcohol fuel and is available in hardware stores. Everclear grain alcohol can be purchased at a liquor store and is about 95% alcohol and will also work. Normal rubbing alcohol contains 30 percent water and does not burn efficiently. Two ounces of alcohol will burn in a stove for approximately 10-15 minutes depending on the stove and type of alcohol.

Apple Box Oven – This oven is constructed with an apple box, heavy duty aluminum foil, spray adhesive (optional), a cooling rack, and blanket for insulation in cold weather. This homemade oven bakes using only 10-14 charcoal briquettes. Use one coal for each 35 degrees desired. 10 coals = 350 degrees (more required in cold weather). Place

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started coals on foil surface, position food on rack and place oven on top. Oven can maintain temperature for 45-55 minutes. NEVER use this indoors! We constructed ours using an oven bag to create a window in the oven. I would not recommend the window as you really can't see the food well and it creates significant heat loss. See directions with pictures, in this issue, for building an "Apple Box Oven."

Battery Bank – A battery bank may be charged with solar power, wind power, household power (when available), or from a generator. Most cooking methods use a large amount of energy and would quickly deplete the batteries. However, using this energy for microwave cooking may be a good option in many situations.

Butane Stove – These stoves are light weight, convenient and easy to use. Many come with an automatic piezo-electric ignition and provide excellent flame control. These are lighter and more portable than liquid fuel stoves. Butane does not vaporize well at near freezing temperatures. The stove may, therefore, sputter and misfire in cold temperatures. The fuel is fairly expensive. One 8 oz butane canister will provide 1-2 hours of burn time at maximum output. The recommended shelf life for a butane canister is eight years. Store with care as the fuel is highly flammable.

Canned Heat – There is a wide variety of canned heat available that will burn from two to six hours. It is safe to use canned heat indoors. The cans are filled with forms of alcohol or a purplish gel (petroleum product) that is flammable but does not burn quickly. It puts out a visible flame and a good amount of heat, but not too high. The heat and flame go straight up with little spread. They are safe, lightweight, store nicely, and are good for heating foods. They can be used with a small Sterno stove, chafing dish, or fondue pot. The shelf life varies depending on the manufacturer between 10 years and indefinite. Store away from heat sources and dispose of damaged or dented cans.

Charcoal – NEVER, NEVER, NEVER burn charcoal indoors! It consumes a tremendous amount of oxygen and produces a vast amount of carbon monoxide which is a deadly poison. It could prove fatal to your entire family. Charcoal is the least expensive fuel per BTU that you can store. Remember to store newspapers or lighter fluid to start the charcoal. Charcoal will store for an extended period of time if it is stored in air tight containers. If it is stored in a paper bag it will absorb moisture and be difficult to light after a few months. It will store indefinitely in an airtight metal or plastic container

Coleman Stove – This camping favorite runs off of "Coleman" fuel or white gas which is inexpensive and widely available. There is a "dual fuel" design that will also run off of unleaded gasoline. Two pints will burn for about two hours with both burners on high. Remember that white gas or "Coleman" fuel produces carbon monoxide and should never be used inside. Coleman fuel stored in an unopened container in a dry place with a stable temperature has a shelf life of five to seven years. An opened container in the same area should be used within one to two years. Use caution when storing the fuel and using the stove.

Cook and Carry System (Made by Thermos/Nissan) – Stainless steel cooking pot with lid allows cooking or heating on stovetop; then fits snuggly into the double wall vacuum insulated outer container to finish cooking and/or hold at temperature for up to 6 hours. Its energy-efficient, vacuum technology keeps cold items cold, too!

This design is the same concept as a hay box only using modern technology and is much more convenient. Place the food in the pot and bring it to a good strong boil. Then place it in the insulated container to finish cooking. It will not cook a large roast well, but does a great job with chili, stews, and soups.

Dutch Oven – This classic method of cooking is a great way to prepare meals, breads, and desserts. With a little experience anyone can become an expert. Dutch ovens are easy to use and store and will last for many years when cared for properly. The charcoals are cheap and when stored in an airtight container will last indefinitely. To make Dutch oven cooking even more energy efficient you may want to try a Volcano. A Volcano cookstove uses one third the normal amount of charcoal. The airflow is regulated and the heat flow is channeled to the sides of the pot so the Dutch oven works even better.

Generator – A generator can be very useful in a charging a battery bank that can power a microwave

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or small appliances. It may also be used to run appliances directly. Most traditional methods of cooking use large amounts of energy and it would not be feasible to power an oven with electricity from a generator for any extended period of time. Never operate a generator indoors as it produces vast amounts of carbon monoxide.

Hay Box – Legend has it that this was used by the early pioneers as well as during WWII to help make the most of limited fuel. The food is brought to a good strong boil and then placed in an insulated box to continue simmering all day. Insulation can be hay, blankets, anything that will insulate the pot with at least four inches on each side. It works great. I like to use a pressure cooker. The trick is to insulate it well against outside temperatures. It takes about four times as long to cook but uses much less fuel.

During our first experiment with a hay box we used two large diaper boxes. I insulated the bottom with four plus inches of left over packing Styrofoam sheets. Around the sides were old blankets and over the top of the pot, an old Styrofoam bead bean bag. We covered it all with another box as a lid. I was skeptical until dinner time came and I removed a steaming hot pot from all of the homemade insulation. The meal was fully cooked and too hot to eat. See directions with pictures, in this issue, for building a "Hay Box" stove.

Kerosene Stoves – There are generally two types of kerosene stoves: wick and pressure. There are many different varieties. A one burner "Sockwick" stove will burn for 13 hours on one gallon of kerosene. Kerosene is a fairly safe and efficient fuel. It may be used indoors with careful ventilation. It smells and smokes when lighting and extinguishing, but burns nicely. Kerosene stores well for a long period of time.

Microwave Oven – Although this uses electricity, it is a great way to cook foods quickly and uses a minimum amount of energy. It can be used to bring food up to temperature and transfer to a thermos, hay box, or another insulated container to finish cooking; thus saving precious energy and fuel.

MRE Heaters – These are designed to heat MRE meals quickly and safely without a fire. You can also heat up other foods that are water tight and small enough to fit in the bag. They are made from powdered food grade iron, magnesium, and sodium. When water is added to the chemicals in the heater it creates a chemical reaction that heats up almost instantly. It takes about 10-15 minutes to heat up food in an MRE. We found that the older ones usually did heat up but it took longer. These are great for 72 hour kits. Note that vapors released by activated heater contain hydrogen, a flammable gas. Do not place an open flame in the vapor. Vapors can also displace oxygen.

Paper Box Oven – Small homemade oven is just big enough to bake a 9 x 13 casserole or cake. It is simple and inexpensive to make. It uses less charcoal than the Apple Box Oven to achieve the same results. I find it easier to bake in than the Apple Box design and it stores nicely. This one is my personal favorite. Never use charcoal indoors! See directions with pictures, in this issue, for building an "Paper Box Oven."

Parabolic Solar Cooker – Another good option when considering cooking with the sun. Because they generally have larger solar collectors than box ovens, they cook faster and can achieve higher cooking temperatures. Beware of stray reflected solar rays as they can be hard on your eyes and possibly create a fire hazard.

Portable Grill – A portable grill with legs can be placed over a fire and makes a good cooking area. Food may be cooked directly on the grill or in pots and pans over the hot coals. The grills are inexpensive ($10-15) and widely available.

Pressure Cooker – This is a must when it comes to conserving energy. Pressure cookers are available in many different sizes and styles. It can make wonderful beans in about 25-30 minutes. It can even soften up some tough older beans. Just bring it up to temperature for a couple of minutes in the morning and then place it in the hay box. Dinner time comes and the food has finished cooking and is still hot and ready to eat.

Propane Stove – These are great for camping and outdoor cooking. One 20 lb tank of propane may provide up to 15 hours of cooking time. The shelf life on propane is nearly indefinite. The tanks however need to be closely

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watched for signs of rust, dents, or anything which may present a problem with leakage. Use in a well ventilated area and store fuel carefully away from the home. Propane is heavier than air and will pool near the floor if the container should leak. Never use propane inside an underground shelter.

Solar Funnel Cooker – This unique design is adapted from Brigham Young University's Professor Steven Jones' solar funnel cooker. It is inexpensive to make and use. The great thing about it is that it uses the sun for energy. It is works well for pasteurizing water and making simple meals. The lid on the black canning jar acts like a pressure cooker decreasing the amount of cooking time required. It takes a little practice to learn how to use it well. See directions with pictures, in this issue, for building an "Solar Funnel Cooker."

Solar Oven – You can find plans on the internet or there are many commercial brands available. A solar oven uses the power of the sun to cook. It even works well on overcast days. We purchased a commercial one and love it. It reaches temperatures up to 400 degrees Fahrenheit. It is easy to use, safe, portable, and almost impossible to burn food. We have baked bread, made cobblers, and some incredible chili. Solar ovens work best between 10 a.m. – 4 p.m. Some directional adjustments may be required during the cooking process to take best advantage of the sun. It is important to start cooking early enough in the day to ensure enough sunlight to finish the dish.

Solid Fuel Tablets (Esbit) – These ½ ounce tablets are designed to work in a pocket stove. One cube will generate up to 1400 degrees of intense heat for 12-15 minutes of useable burn time. One cube will bring one pint of water to a boil in less than 8 minutes. They are non-explosive, portable, smokeless, and light easily. They should be used outdoors and are not good for cooking large amounts of food. They make good fire or charcoal starters. Fuel tablets have an indefinite shelf life if stored in a dry place.

Thermos Cooking – Start with a well-built bottle that is lined with stainless steel. It will hold the heat better and is unbreakable. Place ingredients in the bottle and add boiling water. Quickly secure the lid and shake 20-30 seconds. Then allow the thermos time to do its magic. Rice, pasta, and hot cereals work best in a Thermos bottle.

Tulsi Hybrid Solar Electric Oven - This unique solar oven works three ways: solar only, solar with electric back up, and electric only. The electric only setting typically uses 75% less energy than a standard oven (200-400 Watts). It has all the benefits that come with a solar oven (clean, abundant, renewable energy) and can be powered using minimal electricity as a back up from utility power or battery bank. It is portable and can be used almost anywhere, anytime.

Wood Stove – One of the side effects of cooking on a wood stove is that it also heats the house. This is great in cold weather, but miserable in warm weather. Cooking on a wood stove takes longer than other methods as the fire must be started and managed. It takes lots of practice and trial and error. Start with simple foods until you get the hang of it. Cast iron cookware works best, but heavy steel will do also. It is easy to scorch foods with thinner metals. One of the benefits is that it uses wood which can be easy to obtain and store.

Conclusion

As sure as one day follows another, there will be disasters, emergencies, and challenging times in our future. Acquiring knowledge and experience will free you from the anxiety and emotional trauma that is experienced by those who choose not to prepare. Start now to acquire important tools, learn, practice, and experiment. Try one meal each week using some form of alternative energy. Within the next month, find two new light sources that will provide security to you and your family in a short or long term outage situation.

As part of your education, make sure you understand and apply all appropriate safety precautions, and observe all local laws and ordinances.

We are good examples of ordinary people making preparedness a priority. We have learned a tremendous amount and have found it to be a rewarding experience. Use your creativity and get excited about the learning process. The burnt meals and failed ideas spark a greater desire to succeed. The successes have been most sweet and immensely satisfying. We challenge you to do something now! Knowledge is power! Happy Learning!

Apple Box Oven

Materials Needed:

- Apple box top
- Heavy Duty aluminum foil and aluminum tape
- Plastic cooking bag (for optional window)
- Spray adhesive (optional)
- Cooling rack and 4 pop cans filled with rocks or converted portable grill cut to fit
- Blanket for insulation

1. Cut out a 4x9" window at the top of the apple box if desired. Cut a 1x4" hole on the bottom of both ends of the box to allow air to get to the coals. Tape a piece of the plastic cooking bag over the window area. Cover box with aluminum foil inside and out. This works great by spraying box first with adhesive, attaching foil, and securing with the aluminum tape. Trick is to make sure that none of the cardboard is showing, as it will burn. Note: Some heat loss will occur through the window.

2. Spread a piece of aluminum foil on a flat surface outdoors. Place a converted portable grill or cooling rack (supported by rock filled cans) on top foil. Start charcoals and place evenly on the foil. Put apple box oven over the top and allow oven to pre-heat for a few minutes. Remove box oven long enough to place pan of food on top of the grill or rack and then replace the box oven over the food.

3. This homemade oven bakes using only 10-14 charcoal briquettes. Use one coal for each 35 degrees desired. 10 coals = 350 degrees (may require more when weather is cold). An inverted disposable grill liner is great used over the foil to keep coals off of the ground in cold weather. Oven can maintain temperature for 45-55 minutes. Slip fresh coals underneath if longer cooking time is desired. Insulate by covering with a blanket.

Arrange lit coals on foil

Place food on rack over coals

Place apple box oven over top

Insulate using blanket in cold weather

Wait and enjoy!

NEVER use charcoal inside! Must be used in a well-ventilated area!

Hay Box

Legend has it that this was used by the early pioneers as well as during WWII to help make the most of limited fuel. The food is brought to a good strong boil in the morning and then placed in an insulated box to continue simmering all day. It works great. I like to use a pressure cooker. The trick is to insulate it well against outside temperatures. It takes about four times as long to cook, but requires much less fuel.

Materials Needed:
- Some type of box (wooden or cardboard) or container at least 4" larger than your pot on all sides
- Insulating material: hay, foam, blankets, Styrofoam beads, etc.
- Heavy duty aluminum foil or foil craft paper (optional)

Step 1
Line the box with insulating material to ensure that there are no places to allow air to get into the box. This box was lined with newspaper and covered with stiff Styrofoam packing sheets, cut to fit. Spread hay or other insulation in bottom and on sides of box.

Step 2
I put down a sheet of reflective lining with shiny side in and wrapped it around the pot to reflect the heat back into the pot (optional). Place the pot of boiling food (with a good fitting lid) into the box and cover with more insulation on the top and sides.

Step 3
Make sure that you have at least four inches of good insulation on each side. I used an old Styrofoam beanbag on the very top that I tucked around all the extra spaces.

Step 4
I put another box over the top that had been lined with newspaper. Now just forget about it until dinnertime. When you unpack the pot, you will be amazed that the food has cooked and is still hot.

An extra blanket over the box can provide additional insulation in cold weather. Just make sure that you have at least 4" of insulation on all sides. The more the better. Don't be tempted to open it and check on the food as you will lose too much heat. My experience has been that the food has been piping hot when I take it out. If you find that yours isn't … just bring it backup to a boil before serving. You will be amazed how well this works!

Paper Box Oven

Materials Needed:

- Paper box
- Heavy duty aluminum foil and aluminum tape
- Two wooden dowels or metal supports
- Spray adhesive (optional)
- Pie pan or disposable grill liner
- Blanket for insulation

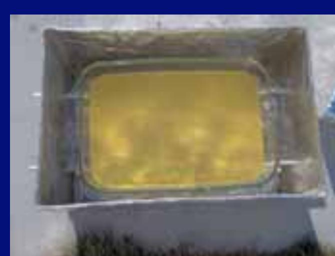
1. Cut two round holes in each side of the box a little more than half way up for the support rods. Cut two holes ¾" x 3-4" on each side close to the bottom to provide air for the charcoals.

2. Cover paper box and lid inside and out with aluminum foil. This works great by spraying box first with adhesive, attaching foil, and securing with the aluminum tape. If your supports are made from wooden dowels cover them with aluminum tape. Trick is to make sure that none of the cardboard is showing, as it will burn.

3. Invert a pie pan or a disposable grill liner on the bottom of the box. You can use anything that will keep the charcoals from sitting directly on the box. Insert the supports and you are ready to cook.

4. Takes only 8-10 briquettes to bake for 60-75 minutes at about 350°. Start coals and place evenly in the bottom of the oven, put food in pan on dowels (a 9x13" pan fits perfectly) and cover with the lid. Insulate by covering with a blanket. When using in cold weather you may need to increase the amount of coals that you use.

Lit briquettes on inverted pan



9x13 pan fits nicely

Cover with lid

Insulate with blanket

Enjoy!!

NEVER use charcoal inside! Must be used in a well ventilated area!

Solar Funnel Cooker

Supplies needed:

- Aluminized Mylar, aluminum foil and cardboard, or reflective car visor
- 3 metal brads
- White plastic support container (ice cream bucket works)
- 1 or 2 quart wide mouth canning jar and lid spray painted with <u>flat</u> black spray paint (on the outside only)
- Wire mesh and a few pieces of sturdy wire
- Large plastic cooking bag
- Twist-tie

1. Cut the reflective material (you can use cardboard with aluminum foil glued to it, aluminized mylar with shiny side in, or a reflective car visor) to 40" x 20" cutting a half circle in the center and punching three small holes along the bottom on each side. Insert one brad in each hole and fasten together so that it creates a funnel. It doesn't matter which way the brads are inserted. You will end up with a funnel.
2. Place a piece of reflective material in the bottom of the white plastic support container. Put the small end of funnel into the container.
3. Make a ring slightly larger than the base of the jar from the wire mesh and fasten it together. Run wires across the center to support the jar.
4. Put food items or water inside the black jar and screw lid on snuggly. Place the cooking bag into the funnel. The wire mesh support goes inside the cooking bag with the black jar on top of it. Blow air into the cooking bag to puff it up so that it does not touch the sides of the jar and tie the top with a twist-tie. This creates a small "green house" around the jar. Be careful not to puncture the bag.
5. Adjust the funnel to maximize the exposure to the sun's rays. For long cooking times you may need to readjust the position to follow the path of the sun. You can stabilize the funnel on windy days by tying a string from each of the small holes in the top corners to a tree or stake in the ground.
6. Use care when handling because it will get very hot. The cooking bag is reusable. The solar cooker works best when the UV index is 7 or higher. Optimal times are between 10am – 4pm. Increase cooking times on partly cloudy days or for larger amounts of food in the jar. Stirring is not necessary for most foods. It is difficult to burn food in the solar cooker.

NOTE: You can pasteurize water (heat to 150° for 10 minutes), cook stews, soups, beans, meats (no need to add water), and bake breads. You do not need to add additional moisture as the top of the jar acts like a pressure cooker.


Step 1


Fasten funnel shape


Step 2


Step 3


Step 4


Step 5


Step 6

Small Alternative Energy System for Disaster Use

By Jay Whimpey, PE

Sometimes 'small' is better or at least as good. There is a tendency, when looking at alternative electrical energy systems, to try to support all of our current energy uses. This usually discourages a large number or people that investigate the subject because alternative energy systems that can support our every day energy needs are prohibitively expensive. The quest to use alternative energy must be accompanied by a quest to significantly curb our energy use.

There is a high probability that normal electrical service to our homes will be interrupted during a disaster and therefore our use of electrical equipment will be limited to the electricity that we can produce. In disaster situations we must choose only the equipment that we absolutely <u>need</u> and then design a system that will address those needs. If we trim down to only the needed equipment then the cost of the system will be much more manageable.

Electrical power production equipment can be very critical in disaster situations, so we should also consider a redundant system for more reliability. Two less expensive systems may be preferable to a single more expensive system.

<u>What are the REAL needs?</u>

I would suggest that the basics for an alternative electrical system are lighting and communication. Both needs can be satisfied by a system capable of charging a 12-volt deep cycle battery and some of the smaller rechargeable batteries that are on the market today, such as AAA, AA, C, D, or 9-volt.

The following information should be helpful to anyone designing a small alternative power system. This information can and should be adapted to individual situations.

The design and specification of an alternative power system should, first of all, consider cost, portability, and redundancy while meeting minimum power requirements for required equipment.

Lighting equipment, such as flashlights, personal headlamps and area lighting are critical in almost all situations. It is impossible to perform even the most basic functions without light. The current availability of light-emitting-diode (LED) lighting has drastically reduced the amount of energy needed for lighting and would be a very wise investment in order to reduce the size and cost of an alternative power system. LED lighting uses less than 1 percent of the power normally required for incandescent or fluorescent lighting. A small personal headlamp using three "AAA" batteries can provide useful light for 50 hours for an individual. An entire room can be lighted for roughly the same amount of time using a battery powered LED lantern and four "D cell" batteries.

While a normal incandescent light bulb may use 60 watts of power, a comparable battery powered LED light would use 0.50 watts.

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A small personal LED headlamp provides enough light to perform most any function using only about 0.10 watts. LED lights are now available from major retailers in the form of area lanterns, flashlights, and small personal headlamps and are designed to operate on rechargeable batteries.

Communication equipment would be next on the hierarchy list and should include a high quality shortwave AM/FM radio so that news and other information can be readily accessed. Many suitable radios are available through 'C. Crane Company' at www.ccrane.com or 1-800-522-8863. The radios will operate on less than 2 watts of power which can be supplied by rechargeable batteries.

A set of two-way radios in either citizens band (CB) or GMRS can be very useful for keeping groups together and staying in communication within a 10-mile radius. Such radios use up to five watts while broadcasting and less than two watts while listening and can operate many hours between replacing rechargeable batteries such as "AA" batteries.

A high-frequency HAM radio might also be useful for long-range two-way communication. High-frequency radios are not dependant upon repeaters and would still function in a mega national disaster. A very capable radio would use roughly 20 watts while broadcasting and less than 5 watts while receiving. Most small HAM radios can operate on a 12-volt DC source.

All radio equipment should be protected in a faraday cage when not in use, in the event of an electro magnetic pulse attack. If possible, purchase redundant communication equipment so that at least one radio is always in the faraday cage.

Other power requirements might include small power tools, refrigerators, or similar equipment. Some of these needs could be addressed using an inverter and a set of 12 volt batteries or a gasoline or diesel powered generator. It is suggested that the higher priority needs be addressed first and that the other less critical needs requiring larger power requirements be looked at carefully since generators require a substantial amount of fuel to operate for extended periods of time and the storage of large amounts of fuel is impractical for most individuals.

A larger power system involving a generator, large battery bank, and inverter to produce AC power from the batteries is expensive and usually is not needed during short term emergencies. For those wishing to learn more about such systems it is recommended that they subscribe to Homepower Magazine at www.home-power.com or 1-800-707-6585.

The following information for a typical situation has been designed to help you design an inexpensive, portable and redundant system.

LIGHTING

- **Personal Headlamps (4)**
  - 0.10 watts
  - 4 hrs/day
  - **1.6 watt hr/day total**
- **Area Lanterns (2)**
  - 0.50 watts
  - 4 hrs/day
  - **4 watt hr/day total**

COMMUNICATION

- **Shortwave Radio**
  - 2.0 watts
  - 5 hrs/day
  - **10 watt hr/day total**
- **GMRS Two-Way Radio**
  - 2.0 watts
  - 1 hr/day
  - **2 watt hr/day total**
- **HAM Radio**
  - **Receiving - 5 watts**
  - 2 hrs/day
  - **10 watt hr/day**
  - **Broadcasting - 20 watts**
  - 0.5 hrs/day
  - **10 watt hr/day**

MISCELLANEOUS

- **Power Tools**
  - 200 watts required
  - 0.5 hrs/day
  - **100 watt hr/day**

TOTAL POWER REQUIREMENTS

137.6 WATT HR/DAY

The total power requirement for this typical case could be addressed by a 40 watt photovoltaic or "solar" panel exposed to the sun for roughly 5 hours per day thus producing 200 watt hours/day. The charging system should be at least 20 percent larger than our actual needs to allow for losses in efficiency in charging and using batteries. Photovoltaic panels cost roughly $5-8 per watt of capacity and can be expected to provide their rated amount of power for at least 20 years. Most panels are guaranteed for that long.

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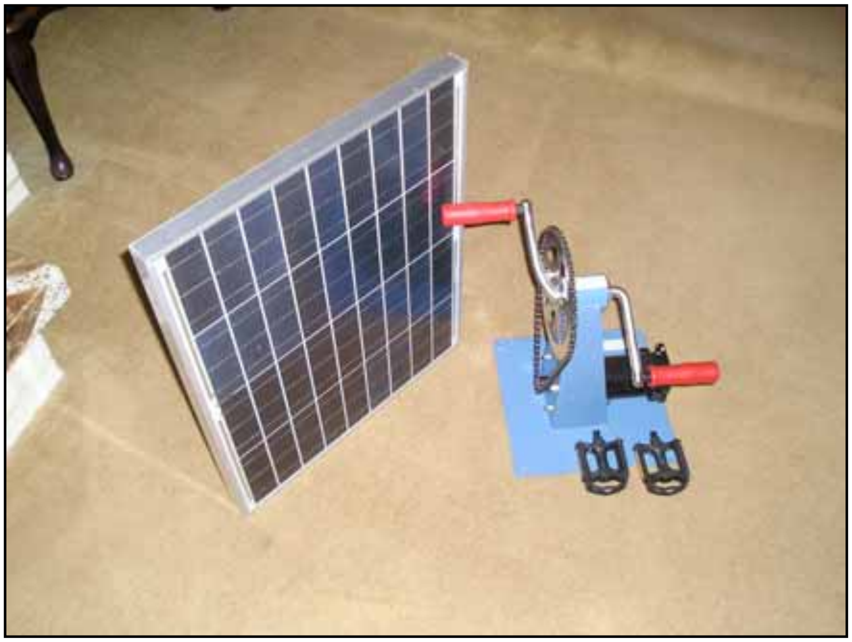
Another type of power generator that should be considered is a human powered generator (HPG).



An adult human can produce roughly 100 watts of power for an extended period of time using either arms or legs or a combination of both. The cost is similar to a solar panel and the generator could be expected to last for many years, similar to a solar panel or wind generator.

The human powered generator could be used in a shelter when it is impossible to use a solar panel or wind generator. A human powered generator can be obtained from Wind Stream Power for roughly $500.00 and can produce over 100 watts of power. The HPG would have to be operated roughly two hours per day in order to supply the needed energy in this typical situation.

Wind generators can also be very effective but they require significant materials and labor for setup and would be useful only when there is a fair amount of wind. The wind generator itself only costs about $2 per watt of generating capacity but the setup definitely adds to the cost. If there is a good amount of wind in your area you may wish to invest in a wind generating system. *Homepower Magazine* would be a good source of information for such systems. Please be advised that wind and fuel driven generators may draw attention to your location and cause a security risk.

The alternative power system normally requires a deep cycle battery to store collected power and help stabilize the voltage for power generating equipment. A suitable battery or batteries can be obtained locally for roughly $100.00 for a 50 amp-hour battery. Absorbed-glass-matt (AGM) or gel batteries are preferable in these applications because they resist sulfation and normally last longer than flooded-cell lead-acid batteries. Be advised that regular car batteries are not suitable for these applications because they do not last very long in deep cycle applications.

Batteries that are designed for golf carts or electric floor scrubbers are much better for alternative power applications. Lead-acid batteries perform better if the amount of discharge between recharge cycles is kept low, and if the batteries remain charged most of the time. The sulfation reaction that causes lead-acid batteries to lose capacity only occurs if the batteries go below 12.4 volts. If the batteries are deeply discharged it is better to bring them back to a full state of charge (12.8 volts) before another discharge cycle.

A charge controller is also required to prevent over charging of the battery bank and discharging of the battery when the generating equipment is inactive. A suitable charge controller is available from Atkinson Electronics, Inc. (1-800-261-3602) that can handle up to 150 watts of 12-volt charging current. Charge controllers should also be used on solar panels.

A required piece of equipment is a battery charger for charging rechargeable AAA, AA, C, D, or 9-volt batteries. These small batteries are used to power the lighting and smaller radio equipment. Most battery chargers on the market for this purpose require a 120-volt AC source (normal household electricity). The *AccuManager 20* battery charger from www.accupower-usa.com is a very good battery charger and has the ability to

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charge these smaller batteries from a 120-volt AC source as well as the larger 12-volt deep cycle battery system, which is a rather rare but very useful feature. It also charges much faster than most other charges.

A small inverter is also very useful for powering miscellaneous 120-volt AC appliances such as battery operated hand tools. The cost of such devices is largely dependent on the capacity but an inverter with a 400 watt capacity can be purchased from many major retailers for roughly $200.00. The inverter uses a 12-volt DC source and converts it into 120-volt AC which is the most common for household appliances.

Make a survey of the household appliances you may need during an emergency and decide how large of an inverter would be required. Try to be prudent in your plan and only prepare for appliances that would be needed in a disaster situation.

A small battery organizer tray that is normally sold with a battery tester would also be very useful for organizing the small AAA, AA, C, D, or 9-volt batteries.

Again, a little bit of preplanning can help a great amount when selecting the lighting and communication equipment to be used. The equipment can be specified so that only one or two sizes of batteries will have to be stored thus reducing the number of batteries that will need to be purchased.

The lighting and communication equipment should be purchased and then tested to ensure that it is in working order before a disaster strikes. It is also a good idea to purchase backup lighting and communication in case the primary equipment fails.

Enough batteries should be purchased to power the selected equipment plus a few extras because batteries can fail also.

There are also decisions to be made regarding what type of rechargeable batteries to purchase. Nickel metal-hydride (NiMH) are preferable in these applications because they can store more energy, have less of a tendency to develop a capacity limiting “memory”, and can be charged more cycles than comparable nickel cadmium (NiCd) batteries. NiMH batteries are normally rated for at least 1000 recharge cycles and can and should be nearly completely discharged each cycle for better battery health and to reduce the amount of recharge cycles. Lithium batteries are also just coming onto the market and promise to be even better in many aspects but they are not commonly available at this time.

Small rechargeable batteries are manufactured with various power ratings and you should expect to pay a little more for higher rated batteries. They are rated in the number or milli or thousandths of an Amp-hour, normally abbreviated as mAh. A “AAA” battery might be rated at 800 mAh, a “AA” battery rated at 2500 mAh, and a “D” battery rated at 8500 mAh. The increased power ratings are due to the increased size of the batteries.

In summary, a very capable alternative power system with total redundancy can be purchased for less that $1500.00. This system would provide power for critical needs during a disaster situation and would also be useful in camping or vacation applications. The price may seem a little steep, but the investment would be well worth it in the even of an emergency situation.

Equipment List

- 1 - 40-watt photovoltaic (solar) panel **$250.00**
- 1 - 100-watt human powered generator **$500.00**
- 2 - 12-volt charge controllers **$120.00**
- 2 - 50 amp-hour deep cycle batteries **$200.00**
- 2 - Accumanager 20 battery chargers **$100.00**
- 2 - 400-watt inverters **$200.00**
- 16 - AA 2500 mAh batteries **$40.00**
- 8 - D 8500 mAh batteries **$40.00**

TOTAL $1350.00

By Sharon Packer

Batteries for Shelters

We have used a number of different batteries in our shelter systems. The three most common types are 12-volt 'deep-cycle' lead acid, 6-volt golf cart batteries, absorbed glass matt (AGM), and 6-volt 'gel-cell' batteries. Car batteries should not be used in shelters, as they have a totally different function. They are only designed for shallow discharge.

We prefer gel-cell or AGM batteries to lead-acid batteries for several reasons: they maintain excellent recovery after numerous charging cycles, they do not outgas, and they have a very long life expectancy. These batteries hold their charge for a long time, discharging at about 1% per month, compared to over 5% for normal lead acid batteries. They are, however, two to three times more expensive than lead-acid batteries. We run ten, 6-volt batteries in our shelter. Our cost for each battery was about $160, for a total outlay of $1,600 in batteries.

During a nuclear disaster we would expect to run the shelter off our battery banks for at least 2 weeks, before recharging. After that period of time, we would recharge with a generator, solar array (if properly stored during the attack) or other alternative power system.

Batteries may be wired in either series or parallel configurations. When batteries are wired in 'series', the positive terminal is wired to the next battery's negative terminal. This combines the voltage of the two batteries in the circuit while maintaining the same amperage available as for one of the batteries. With 'parallel' wiring, the positive terminal is wired to the next battery's positive terminal, and the negative to the next negative. This arrangement combines the amperage, while maintaining the same voltage as one of the batteries. A battery bank may, however, combine both series and parallel wiring configurations. Series strings of batteries are used to achieve the correct voltage, and then a number of these sets are attached in parallel to increase the amps. Always use heavy-duty battery connectors and check with the distributor for your individual wiring require-ments.

In our medium sized shelters (10 x 32), we run two rows of five batteries each, of 6 volt gel- cell batteries. We first wire them in series to increase the voltage. We then connect them in parallel to increase the amperage.

During major emergencies, we plan to use our batteries for only lights and communications.

We have chosen tiny 12 volt, 240 ma DC lights for the shelter. We space them every 8 feet, but only plan to use them sparingly during wartime.

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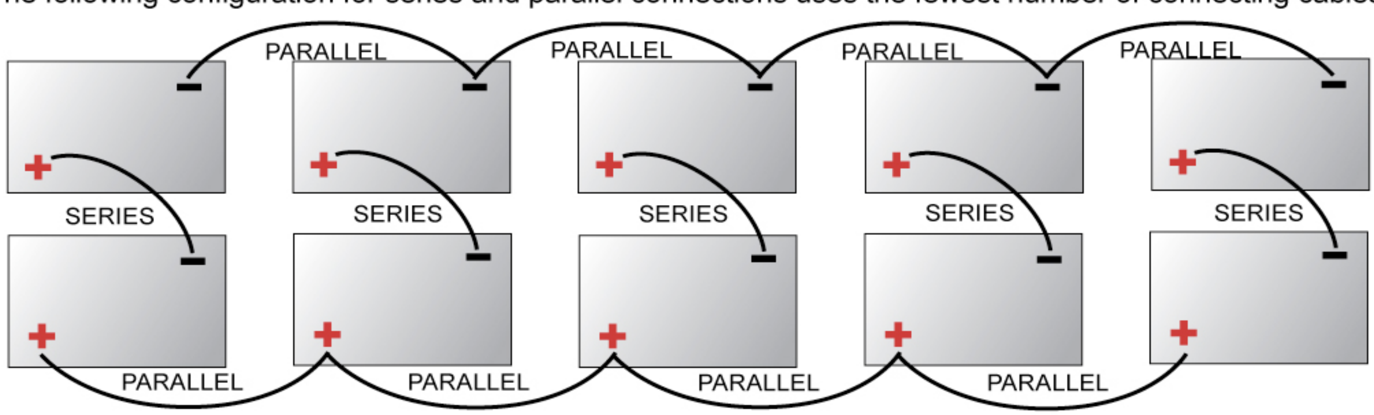
The following configuration for series and parallel connections uses the fewest number of connecting cables.



If using 6-volt gel-cell batteries, this configuration will increase the voltage to 12 volts. Each of these 12-volt sets will provide 180 amps, or 2,160 watt hours. Five sets will provide **900 amp hours or 10,800 watt-hours**. (Volts X amps = watts).

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- One light left on 24 hours per day 'costs' 5.76 amp hours (240 ma X 24 = 5,760 ma or **5.76 amp hours**).
- In a two-week period, the one light will cost 80.64 amp hours (5.76 amp hours X 14 days = **80.64 amp hours**).

LED lights require considerably less power. They are very expensive, however, and they are vulnerable to EMP. We keep a set of LED lights in a faraday cage and would not use them until well after the nuclear event.

Since most two-way communications will come via CB radio, we plan to use our transistorized CB radios about two hours per day during the first two weeks - one hour for transmitting and one hour for receiving. These transistor radios are vulnerable to EMP and there is a risk of burning out the circuitry if there is an EMP attack during that period. CB radios are relatively inexpensive. We, therefore, plan to have 5 or 6 of these radios on hand and will always keep them in a 'faraday cage' (completely surrounded by metal) when not in use.

- Transmitting (.5 amp hours per day X 14 days = 7 amp hours)
- Receiving (.25 amp hours per day X 14 days =3.5 amp hours)
- **Total 10.5 amp hours**

The military Collins K2M radio is a tube type radio and is, therefore, not vulnerable to EMP. The K2M will allow us to communication over very large areas; however, this radio requires a great deal of power to run. We plan to use this radio for a maximum of thirty minutes per day during wartime. If we transmit for 10 minutes and receive for 20 minutes per day, assume the following:

- Transmitting requires 500 watts, or about 42 amp hours in 60 minutes. (500 watts / 12 volts = 42 amps per hour, or 7 amp hours in 10 minutes each day).
- Receiving requires 250 watts per hour, or 21 amps per hour. Since we are receiving for 20 minutes per day, this, also, will result in a cost of 7 amp hours each day.
- Transmitting: 7 amp hours per day X 14 days = 98 amp hours
- Receiving: 7 amp hours per day X 14 days = 98 amp hours
- Consider a 10% inefficiency for the inverter of 20 amp hours
- **Total 216 amp hours**

Total expenditure for shelter:

- **Lights - 81 amp hours**
- **CB Radio - 10.5 amp hours**
- **Collins Radio - 216.0 amp hours**
- **Aprox. total expenditure: 307.5 amp hours**

The total expected amps spent would then be about **307.5 amp hours** of the **900 amp hours** available. This will discharge the batteries by 34%, leaving about 66% of their capacity unused. It is better to leave some amps unspent in case of an emergency and for better battery health. Batteries will last longer if they are not totally discharged during use. Don't spend these amp hours unnecessarily. Hand-pump your air system and eat pre-cooked foods. Wear warm clothing and think only 'survival'.

Solid-state amateur (HAM) radios are expensive and they are vulnerable to EMP. After about two weeks, we plan to use our solid-state multi-band ham radio (Kenwood or other good name brand) for about one hour per day. Our Kenwood uses 30 amps per hour to transmit, and .5 amps per hour to receive. While not using this radio, we keep it in a simple Faraday cage. We will also be intermittently monitoring a shortwave radio.

In remote areas, we leave a sacrificial solar panel outside, to keep a charge on our batteries at all times. We usually run one 40-watt panel. Five hours of sunlight on a 40-watt panel will give us 200 watts per day, which easily keeps the batteries fully charged until we need them. We keep several more solar panels in a faraday cage inside the steel shelter to protect them from a possible EMP. We plan to put our solar array outside the shelter after about 4 weeks.

Draining batteries completely on a regular basis results in a very short service life. Once a lead acid battery is deeply discharged, completely charge the battery before starting another discharge cycle. This procedure helps lengthen battery life. Lead acid batteries, if regularly drained below the 50% level, may give only 5 recharges, and gel-cells and AGM might give only 50 recharges. If gel-cell batteries are regularly recharged before reaching the 50% level, they could give between one thousand and six thousand recharges.

Batteries are extremely important. Take care of them and keep them charged on a regular basis. It would be catastrophic entering shelter in an emergency with uncharged or damaged batteries.

By Bob Owens

Most people in suburbia are grid connected and content. They would like to do something with solar electricity, but really don't know where to begin. I found myself in a similar position. I loved the idea of going solar, but wasn't ready to make a large investment. Instead, I decided to start small and take my wife's home office off the grid. I also decided that I wanted to do the work myself.

With these ideas as a starting point, I designed a small, stand-alone solar-electric system. I wanted:

- To remove a single electrical circuit from the grid, and power it with solar electricity.
- To have an emergency power supply (EPS) during extended utility outages.
- The EPS function to allow a generator to be connected to all the house circuits.
- All circuits to be switch-selectable between utility and generator, with no possibility of the system energizing a downed grid.
- To take advantage of the fact that a PV system produces more electricity in the summer than in the winter. A battery-powered lawn mower would use the excess energy during the summer.
- To install the system by myself, with no special tools.
- All parts to be readily available and costs reasonable, with future upgrades to system capacity already planned.
- To install the system in phases, with each phase able to function independently.

Getting Started

Well, that is quite a list, but I did it! Where did I start? As with any solar energy project, you start with a load analysis. In this case, I wanted to remove one house circuit from the grid, but which one? My wife Barbara uses one of the bedrooms as her office. It contains a computer, scanner, printer, fax machine, and overhead fan with a light on its circuit. It is in use two to four hours each day. Most of the time, only the computer and its monitor are on. We decided that her office would be a good candidate for solar electricity.

The computer draws 200 watts and the monitor another 100, for a total of 300 watts. Assuming that the computer and monitor are used three hours per day, we needed 900 watt-hours per day. The other loads (printer, scanner, fax machine, and lights) were small and only used intermittently—they could be ignored. The fax machine is only turned on when needed. The printer and scanner are plugged into one plug strip switch, eliminating any phantom loads. This had the added benefit of turning both machines on or off with one switch—you couldn't leave anything on by accident.

System Design

How many PV panels would we need to run the office? Stand-alone, battery-based PV systems have an overall system efficiency of roughly 65 percent, and our site receives about five peak sun-hours per day on average. A 300-watt PV array would generate about 975 AC watt-hours per day (300 x 5 x 0.65), enough to cover the office load on a sunny day. Once the number of panels you need has been determined, all other system components can be sized appropriately.

We wanted enough battery storage to run the office for three days without sun. If cloudy periods extended longer than that, the office could be switched back over to the utility grid until the PV system fully recharged the batteries. I calculated the required size of the battery bank as follows. Four, 220-amp-hour (AH), 6-volt (V) deep cycle batteries wired in series–parallel would provide 440 AH of battery storage at 12 volts nominal, or about 5,500 watt-hours (WH) total (440 AH x 12.5 V) during normal operation. But completely discharging your batteries will quickly destroy them, and discharging them less deeply will make them last longer. Limiting the battery discharge to 50 percent gives me an effective storage capacity of about 2,750 WH (5,500 x 0.5), which met my design goal of three days of autonomy.

A 20-amp PWM (pulse-width modulated) charge controller regulates the solar charging. To keep costs down, I went with an inexpensive modified square wave, 600-watt inverter. While a sine wave inverter would have provided higher quality electricity for the office electronics, everything has been running fine so far. Finally, I needed an EPS sub panel to wire into our main house panel. This panel is designed to transfer electrical loads between a backup generator and the grid in case of a grid failure. They are stocked by most hardware and home improvement stores.

System Installation

First, I installed the EPS sub panel, following the manufacturer's directions exactly. Hire an electrician if you don't feel confident about installing this panel yourself.

The next item was the battery box. You can buy a plastic tub, or fabricate a wooden or steel box, and make it as simple or elaborate as needed. I wanted a battery box that would contain all the electronics in a separate compartment from the batteries, and have a cover. I built the box using pressure-treated 3/4-inch (19 mm) plywood, and added a hasp and handle on the lid.

I decided to build my own panel mounts from galvanized steel strut material, bolted together. I assembled as much on the ground as I could. The less time spent on the roof, the better. Once the array was assembled, I tried lifting it. If you have any doubts about your abilities, get some help. An incident on the ground could become an accident on the roof. After pre-positioning the tools and parts I would need up on the roof, I hoisted the array, positioned it, and fastened it directly to the trusses with lag bolts. Silicone sealer was used to keep the roof penetrations watertight.

Wiring

All that was left to do was the wiring. First I connected a bare copper ground wire to each of the PV module frames and to a ground rod. This equipment-grounding approach keeps static electricity from building up on the array, and reduces the chance of lightning damage to the equipment. All of the PV system's electrical equipment is bonded to this same equipment ground. PV wiring between the array and the batteries was run in conduit for safety.

I made up custom battery cables. The lugs were crimped and then sealed with heat-shrink tubing. Next I wired the batteries in series–parallel. An AC battery charger and an inverter were installed

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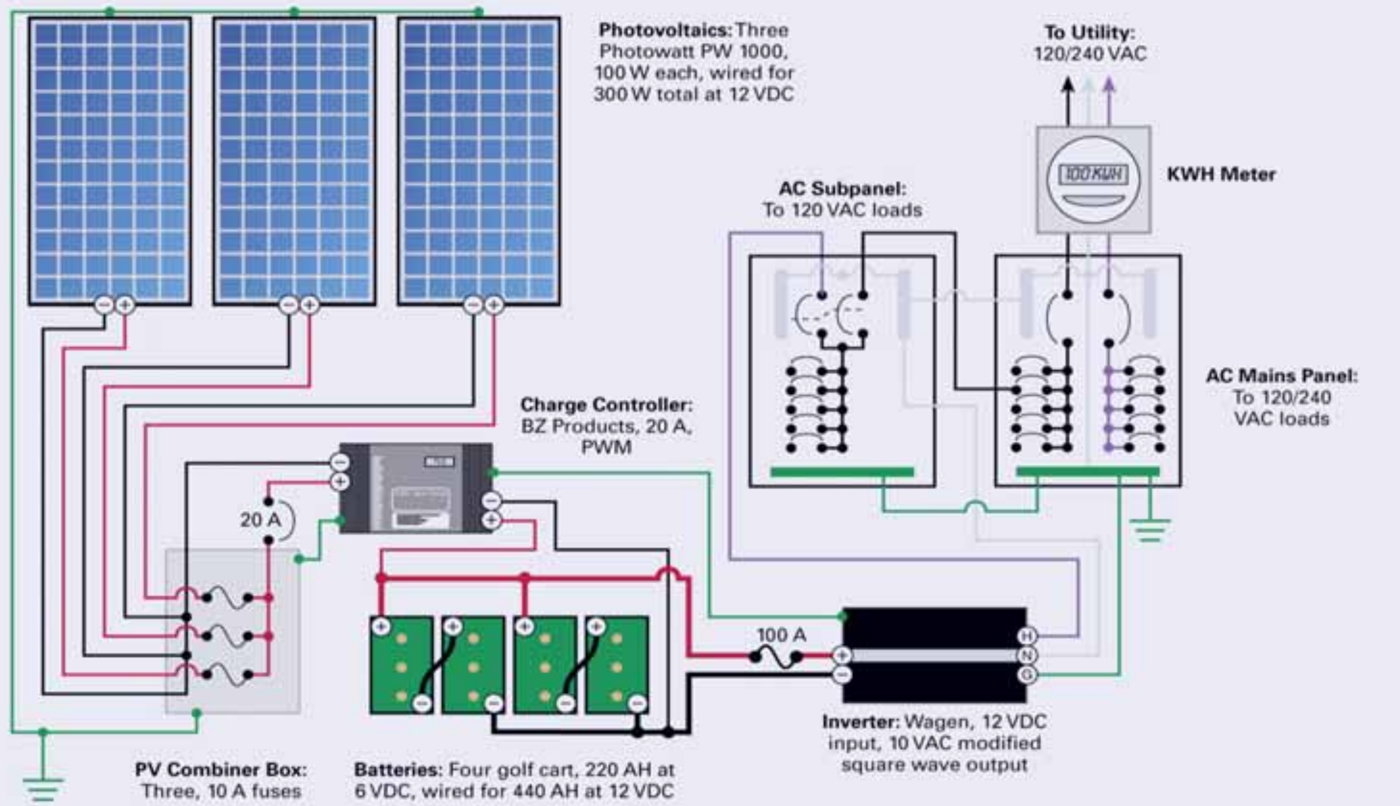

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with breakers to protect against fire, according to the manufacturers' instructions. Finally, I made the connection from the inverter to the transfer panel.

Applications

The solar-electric panels are now powering my wife's office circuit most of the time. If a few cloudy days occur in a row, it is a simple matter to flip the circuit breaker back to using the utility until the batteries get recharged. A breaker in the battery box allows the array to be disconnected easily for any maintenance that may be required.

In the event of an extended utility outage, any circuit in the EPS panel box can be switched over to the solar electric system as needed. With judicious use, the system can provide electricity to select appliances in case of an emergency. This is much more desirable than trying to use flashlights, candles, or generators to get through a crisis.

The last item, the addition of a battery-powered lawn mower to the charging circuit, was the easiest part to accomplish. I went online and bought Sears' best battery powered electric lawn mower. I ran an extension cord from the inverter to the transformer cube that powers the mower's battery charger. Once charging was complete, it was time to try the mower out on the grass. The unit mowed my entire lawn without a problem, and it was easier to maneuver around the lawn than my old gas mower. It was much quieter and didn't require pull-starting, gas, or oil.

Positive Steps

Well, all the goals I initially set have been accomplished and the system has been up and running for about three years. How does it work? It covers the load it was designed for reliably, and worked well within its limits. When Barb's computer use went from two hours a day to more than eight hours, her computer and monitor had to be upgraded to keep up with her needs. The system was not designed for that. More PVs will need to be added to cover the added load.

During the hurricanes in 2004, we had no utility electricity for five days. The PV system was an excellent emergency power system during those times. It's amazing how much better you feel if a couple of house lights are working normally.

It is comforting to go to bed every night knowing that our EPS system is functional and can be turned on with the flip of a switch. There are also the less tangible benefits of contributing less to air pollution and, best of all, the satisfaction that comes from knowing that I have taken a positive, powerful step towards a better future.

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AAA Solar Supply Inc. • 2021 Zearing NW, Albuquerque, NM 87104 • 800-245-0311 • www.aaasolar.com • PVs

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Tools of the Alternative Energy Trade

By Jay Whimpey, PE

Two basic instruments are required for designing, assembling, testing, and maintaining an alternative electric power system, a multimeter and a "Kill a Watt Meter." We cannot see or feel electricity (except in the form of a shock) and we need instrumentation to "sense" what is happening in the electrical system. This can be very important for safety and for the protection of system components as they are being assembled.

Multimeters:

A multimeter has many important functions. There are analog type multimeters around with a meter face and a needle to show the reading, but a digital multimeter (DM) is superior in many aspects because it can handle reverse polarities and is much easier to read.

A DM can be purchased for between $10 and $300 and even the less expensive models do just fine in most situations. They can be purchased at Radio Shack, electrical supply stores, or contact TACDA through our website for more information. The less expensive DMs usually do not have as many features and the probe wires and handles are usually much less rugged (prone to breakage). Don't be afraid of buying a less expensive meter. Just take a little extra care and they will last a good long time.

In my estimation, the Fluke brand meter is the best that can be purchased. They are the standard in the industry and the brand most often used by professionals.

The basic DM measurement functions are alternating current (AC) and direct current (DC) voltages, resistance and amperage testing. The DC voltage function will probably be used the most. This function shows the state of charge of any battery, and verifies that DC charging equipment such as solar panels, wind turbines or human powered generators are working properly. The polarity function insures that an inverter will not be connected in reverse (reversed polarity can seriously damage inverters as well as other components like charge controllers).

The AC voltage function, by measuring the voltage of the current under load, can determine if a generator or inverter has the correct output voltage and can also determine if your AC wiring is heavy enough. If the voltage drops too far at the point of use it would be advisable to use heavier wire. Prior to working on any wiring, the AC voltage function of the DM should be used to check for voltage in the circuit, assuring that it is safe to begin the procedure.

The resistance function measures resistance to electrical flow. Using this function helps determine if electrical connections are made appropriately (they will show very low resistance when made correctly). An open circuit caused by a poor connection will show infinite resistance. This function can be used to determine if a fuse is burned out or if a light bulb is still good. A good fuse or light bulb will show a small but measurable resistance but a bad fuse or bulb will show very high or infinite resistance. This function is also useful to determine if the leads on the DM itself are in good working order by just adjusting the meter to measure resistance and then touching the leads together. If it shows nearly zero resistance then the leads, probes and connections to the meter are in good working order.

An amperage test function is used by placing the DM probes into the circuit being tested. The DM meter then reads the amperage or amount of electricity flowing into that circuit. This function could measure electricity used by a particular appliance or the amount of electricity being produced by a photovoltaic panel or battery charger. There are limitations to how much amperage the meter will handle so some caution is advised. Some DMs will only handle DC circuits. Every meter is slightly different. It is a very good idea to keep the paperwork for your new meter with the meter so that you can refer to the manufacturer's instructions when testing a particular item.

"Kill A Watt" Meter:

The next suggested instrument is a "Kill A Watt" Meter (KAW) manufactured by P3 International. The meter is primarily intended to measure AC loads for determining the required size of an alternative power system, but it has many other possible applications as well. The KAW meter measures the volts, amps, watts, VA, Hertz (frequency), power factor, and kilowatt-hours of an AC circuit. It is also very easy to use. The meter is plugged into a normal AC 120-volt outlet (there is a male connection at the back of the meter), and the AC load (appliance) is plugged into the front of the meter. The meter shows volts and Hertz without having an AC load plugged into the other side and these functions can be used to test the output of a generator or inverter. The other functions are only meaningful when a load is attached.

The KAW meter can not only measure the electrical power requirements instantaneously but can also measure the electricity used by an appliance over an extended period of time. This function is particularly useful when trying to find the load from a refrigerator or freezer that comes on intermittently. The KAW meter can be plugged in for a few days and it accumulates kilowatt-hours used and total hours elapsed so that total power consumption can be determined. This meter would also be helpful to determine if the wiring system is adequate to maintain proper voltage to an appliance during operation. This is important because some appliances can be damaged by a low voltage input. If the voltage drops too low during operation it would be advisable to increase the wire size of the circuit.

The KAW meter does have its limitations in that it can only measure 120-volt AC current with less than 15 amperes total load. This does, however, cover nearly all appliances normally used in our homes and therefore, has wide applicability. The meter is very simple to use with one or two functions for each of five buttons. You just press the button once to read that measurement and press the same button again to toggle between measurements when two functions are indicated for one button. The display clearly shows which function is being displayed at the time.

The KAW meter is available from www.P3internationl.com for roughly $50. For more information contact TACDA at 1-800-425-5397 or info@tacda.org.

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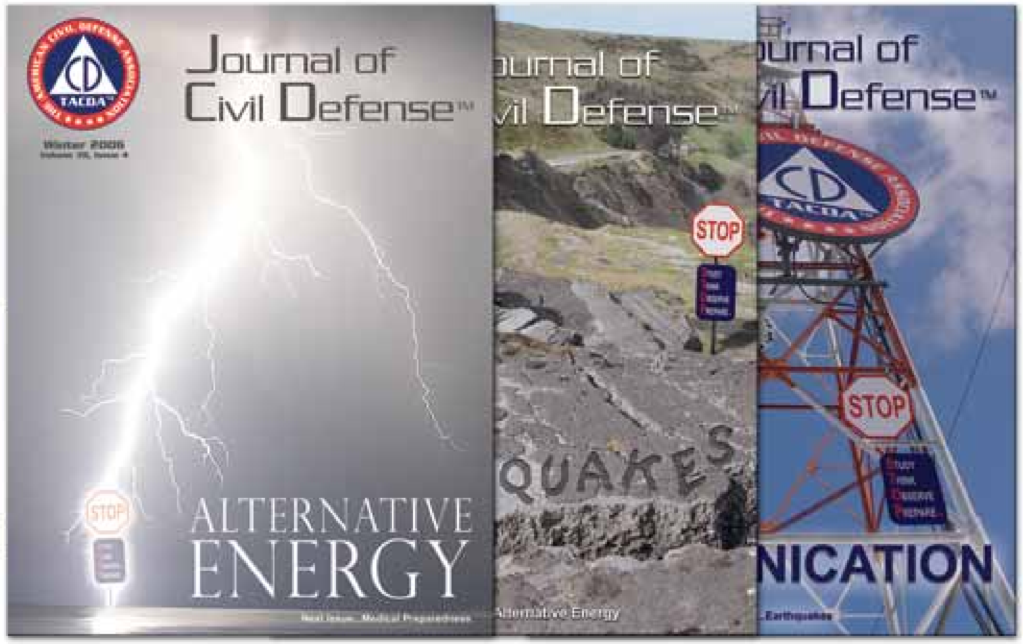

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ISSN# 0740-5537