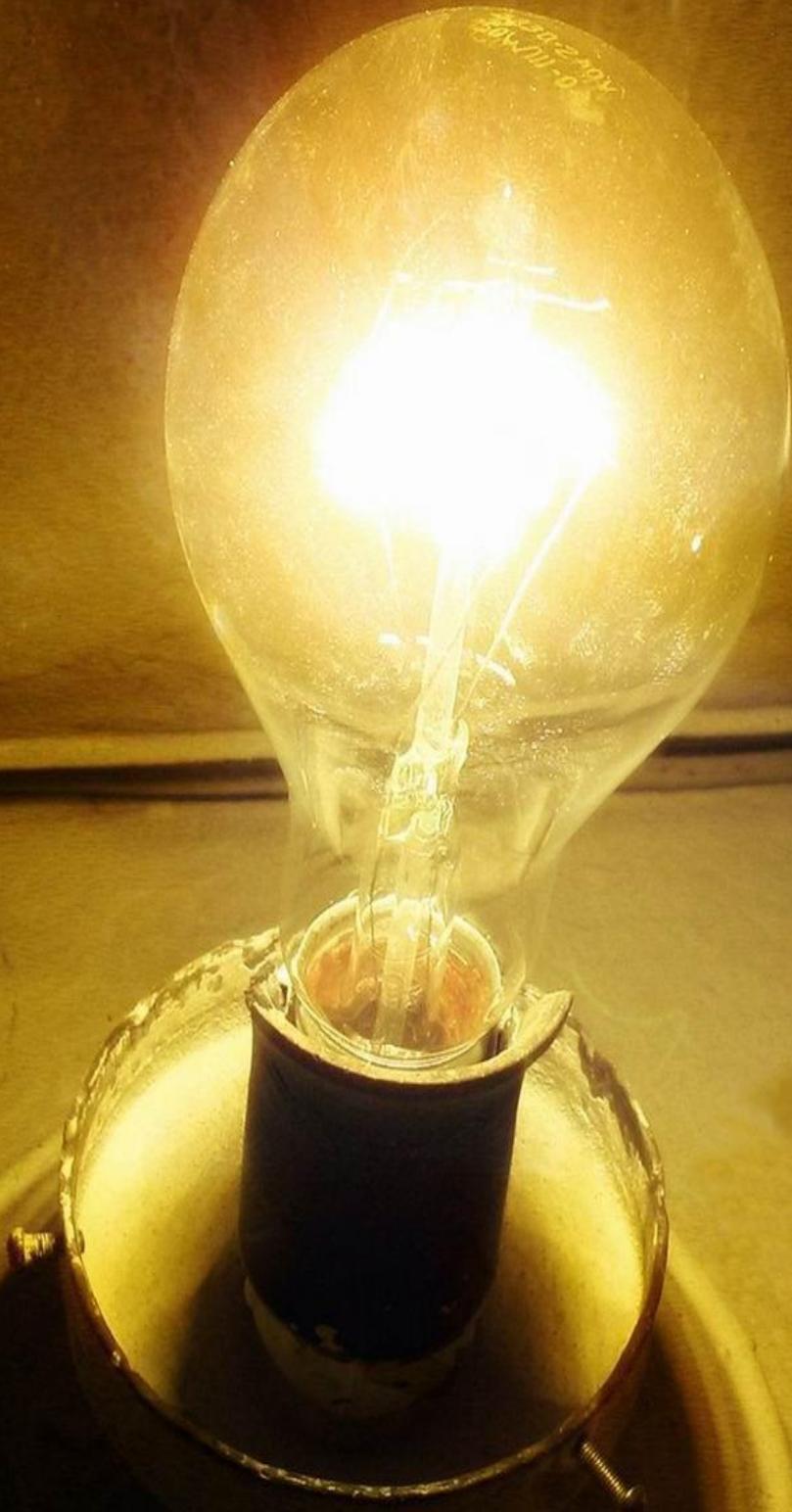


POWER EMERGENCY GUIDE



You can face this!

Let's be honest here! It's going to happen. Sooner or later, the power will go off, and you won't know when (or if) it will come back on. This doesn't have to be the work of evil-doers, either. It could be a sudden ice storm that brings down the power lines. It could result from other severe weather such as a tornado or hurricane, or from a disruption caused by faulty power company equipment, or even something as simple as a tree branch falling on your own personal segment of the grid.

The effect is the same: everything electrical in your home stops working. Don't panic! With the right preparedness, you'll get over this like a king! And we'll make sure you own those preparedness secrets for when you'll need them.

For most modern Americans, the loss of power means the complete loss of normalcy. Their lifestyle is so dependent upon

the grid's constancy that they do not know how to function without it. How do you cook a meal if your gas stove has an electric ignition? How do your children find their way to the bathroom at night if the light switches don't work?

How do you keep warm if your wood heat is moved through ducts by an electric fan? What do you do with a freezer full of expensive meat? How do you find out what is happening in your area with the TV and radio silent? What will you drink if your water comes from a system dependent on electrical pumps?

We'll look at these issues in the broad context of living without access to the grid, whether you've chosen to separate from it or whether the choice is made for you by outside forces. What you can do now to mitigate your difficulties if the power goes off in the future, and what you can do then to help keep your situation under control, will be the focus of this guide.

Remember, too, that an important principle in all preparations is that you maintain as much "normalcy" in your lifestyle as possible. For example, if television is part of your relaxation and unwinding

process, don't assume you can easily do without it. The closer you can keep your daily routines to "the norm" for your family, the more easily you can deal with power outages.

There are five primary areas that are easily disrupted if the power goes off. Each of these is critical to daily survival, as well, so when making preparations for emergencies keep these in mind. In order of importance, they are: light, water, cooking, heating/cooling, and communication.

Light

While living on our Ozark farm without the grid, we spent some time rising with the sun and going to bed when the sun set. This would probably have been a pretty healthy way to live, if everyone else in the world did the same thing. Our children's bathroom needs didn't stop when the sun went down, our neighbors figured that nighttime visits weren't out of the ordinary, and those midnight raids on the pantry for crackers and peanut butter turned into fumble-fests.

Sometimes the barking of our livestock guardian dogs meant strange predators were too close for comfort, somewhere in the countryside darkness. Light is the most important item on our Big Five list because without light we are not able to efficiently carry on the other activities of daily living.

The most simple and familiar form of emergency lighting is a flashlight. Do you have one that you could find in the dark, right now? If so, congratulations. You are among a very small percentage of Americans.

Better yet if you have one for each member of your family, with fresh batteries, plus three extra sets of batteries for each flashlight. That should be your minimum “safe” number. Store your flashlight where you can quickly reach it in the dark night—under the mattress of your bed, for example. Each child old enough to walk should also have his or her own flashlight, and be taught how to use it.

Flashlights range in price from the 79 cent cheapie to the fancy multi-function \$80 special. Consider a small 2-AA battery flashlight with a halogen bulb. These cost about \$4-5 each, give an excellent clear white light, and are easily portable in a pocket or purse.

Additionally, when we discuss communications later, the most common battery used in these devices is also the AA, so your life will be simplified if you stick primarily to one type of battery and don't have to buy various odd sizes for different needs.

Batteries wear out rapidly if your flashlights are used continuously: figure two changes per week of regular use.

Alkaline batteries last longer, give a more powerful light, but cost more than regular batteries. Most rechargeable batteries are suitable for flashlights, but should be recharged when the light begins to dim a little. Don't let them get completely drained. This means you would need several sets of rechargables for each flashlight (some would be recharging while you use the others).

Recharging can be done by means of a charger plugged into your car's cigarette lighter outlet. These DC-powered rechargers can be found at auto supply stores and at Radio Shack for about \$30 or less. Solar rechargers work slower but produce the same results for about \$30.

Candles are available, slightly used, at garage sales and thrift stores (5 cents to 10 cents each or less), and some outlet stores like Big Lots have new candles for 25 cents.

We have a cardboard box weighing 35 pounds that is filled with various sizes and shapes of candles. This would be about a year's supply for my family. We've acquired them gradually, every time we found them inexpensively. They never go bad! Candles are easy to use and familiar. Most of us can adjust to using candles easily. The light is soft and wavering.

You'll need at least three candles if you hope to read by the light. If you have small children or indoor pets, care must be taken where you place them. Metal candle holders that hang on walls

are probably the safest. Remember to place a heat proof plate underneath the holder to catch drippings. Save your wax drippings, too, to make more candles later.

Oil (kerosene) lamps produce a steadier light than candles. Department store oil lamps cost about \$10 each and come in attractive styles. Lamp oil is about \$3 per liter. A typical lamp will burn one to two cups of oil per night, so you would use about two liters each week per lamp.

The light from these lamps is not quite adequate to read by unless it is placed very close, and the light does waver a little. A single lamp can provide enough light in a room so that you don't bump into furniture, but two or three may be needed to provide good functional light. As with candles, if you have children, these lamps need to be placed securely and out of reach.

The smell of burning oil Cooking bread outdoors in a Dutch Oven

(kerosene) can get heavy in a closed room so keep ventilation open. Keep an extra set of wicks (\$2) and chimneys (\$3) in case of breakage.

The Cadillac of oil lamps is the Aladdin Lamp. These run from \$60 up to several hundred each.

The light given off is as good as a 60-watt bulb, clear, and unwavering. You can read or do needlepoint by the light of one lamp. These burn the same oil or kerosene as typical lamps, but because they burn hotter, there is much less odor.

Position these lamps so that they cannot accidentally be overturned, and so that the intense heat coming from the chimney won't ignite something. Purchase an additional "mantle" (the light-giving portion of the lamp - \$3), and chimney (\$15), as backups.

Solar powered lamps (\$80-\$120) are typically small fluorescents, and can be run off of battery systems. It may take more than one day of bright sunlight to recharge these lamps, so you may need several—one to use, while others are recharging. The light is

white and clear, good for area-lighting, and rather difficult to read by. Have extra fluorescent bulbs on hand, too.

Don't forget to store matches!

Water

If you live in a town or city, the loss of power to homes and businesses probably will not immediately affect your water pressure, but it could affect the purification process or allow reverse seepage of contaminants into the lines. If, instead, your water comes from an electrically-powered home water pump, your water stops flowing the moment the power does. Either way, with the loss of power comes the loss of water (or, at least, clean water). Water that is free of bacteria and contaminants is so crucial to our survival that it should be a special concern in your preparations.

The easiest way to guarantee quality water is to store it right now. The important question is: how much? Both Red Cross and FEMA suggest a minimum of one gallon per day per person. This is an

absolute minimum, and covers only your real drinking and cooking needs; bathing is out of the question.

The typical American currently uses around 70 gallons a day, taking a nice long hot shower, flushing the toilet several times, washing a load of laundry, letting the water run while brushing teeth, and for cooking and drinking. In a short-term emergency situation, only drinking and cooking water is crucial, but if that short-term incident drags out to weeks or months, daily consumption would rise to include bathing and clothes washing. And this presumes that the family has prepared a sanitary “outhouse,” so flushing isn’t needed. In that case, 5-10 gallons per day per person would be a more reasonable amount, with a weekly communal bath becoming the routine.

One to three-gallon jugs, direct from the supermarket, run about 60 cents to \$2; these store easily under cabinets and counters. A few tucked into the freezer will help keep things cold if the power goes off. You can also store water inexpensively in large, covered plastic trash cans; they hold 36 to 55 gallons each. Refresh the

water every two weeks, so it will be ready in case the power goes off.

Kiddie swimming pools—a 12-foot wide, 36-inch deep pool holds 2500 gallons and costs about \$250—also make excellent above-ground holding tanks. Buy a pool cover, as well, to keep bugs out.

Farm supply stores often sell “water tanks” made of heavy grade plastic. These can be partially buried underground to keep water cooler and less susceptible to mold and bacteria. These run about \$1 per gallon of holding capacity, so a 350-gallon tank new will cost \$350. Plan to filter and purify the water before use.

Collecting water can be done by hand with 5-gallon plastic buckets if you live near a river or stream (it must be filtered and purified before use). You can also divert rainwater off your roof, through the rain gutters and downspouts into plastic trashcans. If you live in the Midwest, Northwest, or East Coast, rainfall is adequate to make this your primary backup water source.

West Coast, high desert, and mountain areas, though, won't have sufficient rainfall to make this a reliable source.

A drilled well with an electric pump can be retrofitted with a plastic hand-pump for about \$400 - \$600. These systems sit side-by-side with your electric pump down the same well-shaft, and can be put to use any time the power is off. Typical delivery is about 2 gallons per minute, and pumping strength varies from 11 to 20 pounds—a good but not exhausting workout.

Water can be purified inexpensively. Fifteen drops of bleach (plain unscented) per gallon of water costs less than 1 penny, and $\frac{1}{4}$ cup of hydrogen peroxide (3%) per gallon will also destroy bacteria. Twenty minutes of a hard, rolling boil will, too. Bleach is effective against both cholera and typhoid and has kept American water supplies safe for decades. The chlorine taste can be easily removed with a charcoal filter system (such as Brita Pitcher or Pur brands for home use, about \$30).

British Berkefeld water filters, along with various other brands, are more expensive (\$150-\$250), but can filter and purify water indefinitely. Both eliminate bacteria, contaminants, and off-flavors. We've used a "Big Berkey" for four or five years, and it is a very reliable gravity-fed system. When shopping for filters, if they only offer "better taste" they won't protect you from bacterial contaminants.

Noah Water System's travel companion will work great in case of a power outage, or your water supply becomes undrinkable. The Trekker is a portable water purification unit. With the Trekker you can get water from any river, lake, or pond. It's small enough to carry like a briefcase.

Cooking

A person can survive indefinitely opening cold cans of beans for meals, but it wouldn't be a very satisfying existence. In times of crisis, a hot meal goes a long way toward soothing the day's troubles. The simplest way to heat a meal is the Boy Scout

method: a couple of bricks or rocks set around a small outdoor fire, with the bean can propped over the flames. It's low cost, and it works. However, the cook doesn't have much control over the outcome.

Outdoor cooking of all kinds, including grilling and barbecuing, all work during emergency situations, provided you have the charcoal or wood (and matches!) needed to get the heat going. These are familiar methods, too, so family members don't have to make a huge leap to accept these foods. It's difficult to cook much more than meats and a few firm vegetables over open heat like this, though. Also, never use these devices in a confined space, as they emit carbon monoxide.

“Campfire” cooking can lend itself to some baking, if you also have a cast iron Dutch Oven—a large, heavy, cast iron covered pot. Place a well-kneaded pound of bread dough into a heavily-greased or oiled Dutch Oven and put the cover in position. Make a hole or pot-sized well in the ash near the fire, and line this with glowing coals. Put about an inch of ash over the coals, and place

the Dutch Oven into this. Now, pile about an inch of hot ash around the oven and cover with glowing coals, then another layer of ash to keep the heat in. Uncover and check your bread in about 35 minutes, it should be done.

Propane and butane camp stoves are so much like ordinary home stoves that there is no difference in the cooking results. Portable RV 2-burner propane stoves are often available used—mine cost \$5 at a garage sale—and can even do pressure canning because the heat is consistent and reliable. A typical 18-gallon propane cylinder, the kind used for barbeques, costs around \$30 new, and a propane fill up is about \$7. This will last for nearly a month of daily use. You'll also need a feeder hose and pressure regulator for the stove, which can be prepared by your propane dealer for \$20 or so.

Butane stoves are also portable and run off of a cylinder of the same kind of butane that is used in cigarette lighters. These stoves are \$80-90 new, and cylinders are \$5 and last for 8 hours of cooking.

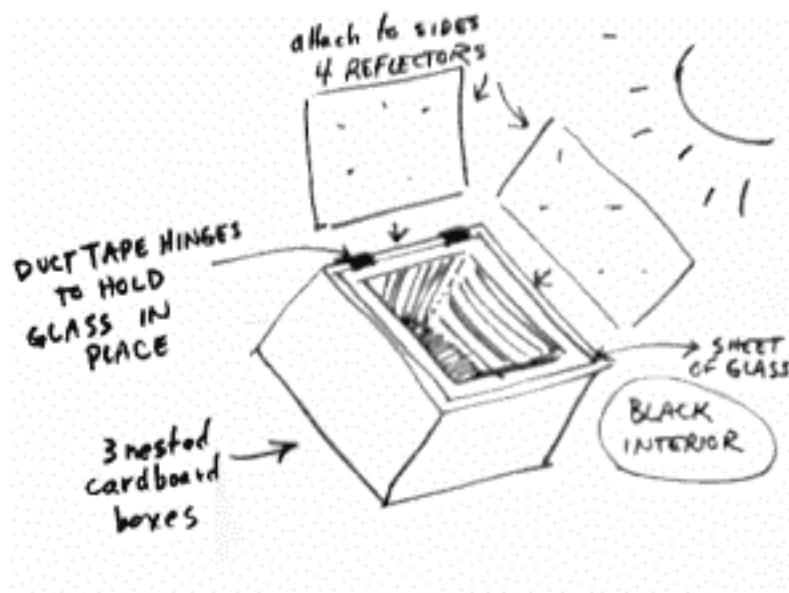
General camp stoves (around \$65 at department stores) operate on “stove fuel” (basically, propane in a small 1-pound cylinder - \$3). A cylinder lasts for around 8 hours of cooking. You can also find camp stoves that will cook off of unleaded gasoline, and there are some that are “multifuel,” using either kerosene or gasoline—handy in case of a shortage of one fuel or the other. Use outdoors or on a covered porch to prevent carbon monoxide buildup in your home.

Solar cooking is another option, if you have plenty of unobstructed sunlight and someone who is willing to adjust the cooker to face the sun every half hour or so. A solar oven need be no more fancy than a set of nested cardboard boxes painted flat black on the inside with tempura colors, a sheet of window glass, and some aluminum foil glued to cardboard panels. Total cost for this, if you can scrounge leftover glass and cardboard, is about \$1.

Place your food in a covered lightweight pan inside the box, prop it so the entire interior is exposed to the sunlight (about a

45-degree angle), cover with the sheet of glass (and tape the glass so it won't slide), then prop the aluminum foil panels so that they reflect more sunlight down into the box. Move the box every 30 minutes so it maintains an even temperature. It will get hot fast, easily up to 325 degrees, and hold the heat as long as it faces the sun.

Remember to use potholders when removing your foods! Our first solar oven had a black plastic trash bag as a heat-absorbing inner surface; it worked superbly until the plastic actually melted.



Above you have a solar oven design made with cardboard boxes, aluminum foil and a piece of window glass. Interior of the box is flat black paint.

Keeping foods cool if the power goes out can be as simple as looking for shade, even under a tree. Some Ozarkers have partially buried old broken freezers in the shade of backyard trees, storing grains and winter vegetables inside.

During the winter, your parked car will stay at the same temperature as the outside air—below freezing on those cold nights—so you can store frozen goods there safely. During the daylight hours, the car interior will heat up, though, if it's in the sun. Park it in the shade of the house, or cover the windows and roof with a blanket to keep the interior cool.

Kerosene refrigerator/freezers are alternative appliances that will continue to function with the power off because they are “powered” by kerosene. Their cooling and freezing capacity is exactly the same as a regular refrigerator, and they come in the

same colors. Typically, they are a little smaller than conventional 'fridges and cost up to \$1500, but they'll last for decades with care.

Portable battery-powered refrigerators that keep your foods 40-degrees cooler than outside temperatures are available at most department store sporting-goods sections (\$90). These run off of both DC and AC power, so they can be plugged into your car battery through the cigarette lighter outlet or into a solar power system.

What about that freezer full of expensive meat if the power goes off? First step is to cover the freezer with blankets to help retain the cold. Then, find dry ice (if everyone else in your town hasn't already bought out the supply). Blanket coverings will keep a full freezer frozen for two days, and the addition of dry ice will prolong that to three or four days.

A solar oven design made with cardboard boxes, aluminum foil, and a piece of window glass. Interior of the box is flat black paint.

If power stays off, it's time to eat and time to can the meat remaining. Canning low-acid foods like meat calls for a pressure canner (\$90), canning jars (\$6 for 12), a source of consistent heat (like a propane RV stove), and some skill. In considering your time requirements, it took me two days of steady canning to put a 230-pound pig into jars. Each quart jar holds 3 pounds of meat.

Heating and cooling

It's a funny thing that even though we know winter is coming, we put off cutting our wood until after the first really cold night has chilled the house below comfort levels. But with the instability in the world today, it is sensible, and reasonable, to prepare well in advance of season changes.

Putting in supplies a year ahead of time is a traditional farm practice, and it gives a cushion of safety against uncertain conditions.

Woodstove heating is more common, and comfortable to use, than it was two decades ago.

New wood heaters run from \$100 to several thousands, depending on materials, craftsmanship, and beauty. Better stoves hold heat longer and may have interior baffles that let you use less wood to produce more heat. Even so, the most basic metal-drum-turned-stove also works to heat a room or a house.

Heating a 3-bedroom home that is moderately insulated will use about 8-12 cords of wood throughout the winter. The size of a cord (sometimes called a “rick” or a “rank”) is not standardized from region to region, but typically will be about 8' x 8' x 2', roughly a pickup truck bed loaded even with the top of the sides. Prices will vary between \$65 per cord to \$150, depending on the region and type of wood.

Hardwoods, such as oak and walnut, and fruitwoods like apple and pear, burn better and longer than softwoods like poplar. Don't use resinous woods, such as the pines, cedars, and spruces for the main heating—only as firestarters—because they burn too hot

and fast and generate creosote. Better home insulation and better quality hardwoods will decrease the amount of wood you need to use.

If you plan to secure and cut your own firewood, be willing to acquire a good-quality chainsaw— any that cost below \$200 will only give you grief. Keep an extra chain on hand. Use safety precautions, too: wear ear and eye protectors, heavy gloves, and don't chainsaw alone. Cutting your own wood will decrease your heating costs significantly, but increase your labor. It typically takes us a full week of constant work to put up a winter's worth of wood.

Woodstoves require heat-proof surfaces surrounding them, an insulated chimney pipe (about \$90 per 3-foot section), and some building skills in order to install. Installation costs can equal or surpass the cost of the stove itself. Chimneys need to be thoroughly cleaned of the black crusty buildup, creosote, at least twice each year (and more often if you use the stove continuously).

Propane heaters that don't need venting to outdoors are a relatively new product. A plain one (\$200) can be mounted on the wall in the home's main room, or more fancy models that look like built-in fireplaces complete with fake logs (\$450) are available. You will need a propane tank, regulator, and appropriate copper lines, but these will all be installed by your propane company for a small charge. Propane has varied widely in cost from year to year, but typically runs around \$0.95 to \$1.30 per gallon.

Kerosene heaters (\$120) are freestanding units that burn kerosene in a way that is something like a lamp—it uses a wick system and flames to provide heat. These are best used in areas that can be easily ventilated, because of the potential for buildup of carbon monoxide. Kerosene has a strong odor, as well. Kerosene costs about \$1 per gallon or less (in quantity).

Solar heat can be “grabbed” anytime the light from the sun hits your house. Even in the dead of winter, the south-facing walls will feel noticeably warmer than the shaded north-facing ones. You

can “store” the sun’s heat in any surface. Ceramic floor tiles, for instance, are excellent at retaining heat. So will a flat-black painted covered plastic trash can filled with water. If these surfaces are exposed to sunlight, say, indoors next to a south-facing window, they will absorb heat during the day. At night, with the window curtains closed, the surface will release heat slowly and steadily into the house.

One of the most efficient ways to heat is something else we have forgotten in the past 50 years— close off rooms that are not being used. If doors aren’t available, you can hang curtains in doorways (or even tack up a blanket, in a pinch), and keep your heat restricted to the room you are actually in. In an emergency situation, you can curtain up a room and set up a tent-like “den” for the family to snuggle in under blankets. Body heat alone will keep the den’s interior comfortable.

Cooling a residence during a hot summer requires just as much thought and advance planning as winter heating does. Battery and solar-powered fans help keep air moving, windows can be

shaded by fast-growing vines and pole beans, and—planning way ahead—fast-growing trees like poplars can be planted on the house's south side to shade the yard.

In areas where wind blows routinely in the summer, you can soak a sheet, ring it out, and hang it in front of a breezy window. The air passing through the window is cooled as it moves against the wet sheet, and helps to cool the house. Remember that heat rises, so make it easy for too-hot air to escape from the attic and upper floors by opening windows and vents.

Communications

In a time of distress, keeping in contact with family and knowing about local and national situations is important to maintaining both continuity and confidence. In general, telephone systems are on a different system than the electrical power grid, but they can be disrupted if there are earth movements or as the result of terrorist activities.

During the Loma Prieta earthquake in 1989, we kept informed about the damages by watching a 4-inch black and white TV set (bought used for \$25) that was plugged into our car battery through the cigarette lighter. At night, we heard reports from the BBC via a 4-AA battery powered shortwave radio (\$70 from Radio Shack). I consider these two devices—shortwave and TV—the required minimum communication/ information devices during a crisis, especially if the phone system is down.

Satellite internet hookups, using a battery-powered laptop, could be an excellent communication tool, both for accessing news and for staying in touch with friends and colleagues by email.

Citizens Band (CB) radios are excellent tools, as well. These portable devices can be carried with you into the field and used to stay in contact with neighbors and family when you are away from the house. Basic models run \$60—you'll need at least two—and ones with greater ranges and features are more costly. They'll run on 6 to 8 (or more) AA batteries.

“Family Radios” are FM-band devices that have a short range, about ¼ mile (\$60 for a pair).

These are handy for keeping family in contact during outings, when traveling in a caravan, or when one member needs to go out to the barn during a storm. They run on 2 AA batteries.

Keeping things normal

Even though circumstances may change in the world, we can choose how we wish to react. We can live in a state of helpless anxiety—or control what we can. We can control our responses, in part, by maintaining as much normalcy in our lives as possible.

If your family relaxes in the evenings with a video, plan to continue doing that. Acquire a battery-powered TV/VCR combination, and make sure you have enough power sources to keep that going for at least two weeks. (If things get dicey, you can wean off the system in two weeks.) A cassette player or CD player with external speakers can provide relaxation and entertainment, and they run off of AA batteries as well.

Children have difficulty adjusting to sudden changes in their environment, so if you expect them to play board games if the power goes out, they should be comfortable with board games now.

Keep routines consistent, arising at the usual time in the morning and going to bed as you have in the past. Prepare familiar meals with foods everyone enjoys. Have “fun foods” and goodies on hand. Remember to reach out to your neighbors and older folks who live nearby, and provide extras to help them, as well.

Use the knowledge you’ve gained, and your experience with non-electric living, to make your neighborhood a more secure and adaptable place.

What if the electricity GOES OFF?

Just as everyone was getting ready to throw the party of the century and millennium—out with the old and in with the new—

someone springs Y2K on us. Power outages, banking woes, communication breakdowns, and even economic collapse are some of the predictions I've heard.

There is indeed a kind of convergence happening here. The changeover to the Euro-dollar is imminent. The satellites that make up the GPS (global positioning system) network will automatically reset to zero in late 1999. Things certainly look exciting for the turn of the century.

I guess you have to walk on the planet for more than 50 years, be in a war, have a wife and children, and fight a whole bunch of issues for a long time to know that this feels familiar. The name changes, the date shifts, but it's the same question:

Are you ready?

People generally agree that something's going to happen, yet we don't yet know the nature of the beast. It has many faces.

Earthquake, fire, flood, plague, meteor strike, nuclear attack,

hurricane, and tornado—all strike in the moment. Economic collapse, crop failure, famine, and nuclear winter are forces of siege that could last months, years, or decades.

From a distance, the first evidence may be a blackout or a news report. The area affected by the disaster will dictate the probability, frequency, and durations of blackouts. If the scope of the disaster is large, other services—water, natural gas, gasoline, fuels, food, and goods—will fail.

Following that will be the loss of phones, police, fire, rescue, utility, Red Cross, and government services.

It is said that crisis has two components: danger and opportunity. There is danger in a crisis— catastrophe, collapse, and chaos. There is opportunity in crisis—restoration, renewal, and revival. Preparedness doesn't mean you'll survive, but it won't contribute to your demise.

There are issues that are specific to living in a city or in the country, so I will treat each as distinct scenarios. As you discover

issues that approximate ones you may experience, you will likely be drawn to research these topics in more detail.

A blackout is a likely scenario in either a short-term or long-term crisis, so that is a good place to begin.

Blackout ready

As winter storms roll in and you prepare for the effects of rain, wind, and cold, what plans can you make to handle an interruption of utility power? Most of us have experienced a blackout before.

Has it been just an annoyance and inconvenience to you? Or was it disruptive to your life or business? There's not much anyone can do to prevent a utility blackout, but there are ways to mitigate its impact on your lifestyle whenever it does happen.

Is readiness for a blackout worthy of your consideration? Cost-cutting measures by utility companies throughout the USA have eliminated programs that protect utility lines from growing or falling trees. The new policy seems to be "fix it only if it's broken."

Severe storms, then, will most certainly impact utility service. An interruption lasting one or more days is more real a possibility than ever.

The pressing question when a blackout occurs is:

When will it end? Virtually anyone can put up with a few hours of interruption. Just break out the candles, don warmer clothes, and read a book or enjoy the company of a friend. The average blackout is a pop quiz. “Are you ready?” it asks. When the blackout continues, with no end in sight, the need for light, heat, water, and food grows.

What’s important in the home?

There are four critical loads in a home affected by a blackout: lighting, heating, refrigeration, and the water system. More specifically:

- **Lighting.** Lighting is essential for overall safety, particularly at night. Fortunately, it need not be electric. Candles, flashlights, and kerosene lanterns are traditional lighting sources for blackouts. Preparation for a blackout requires stockpiling matches, candles, batteries, or fuel for lanterns. Don't forget to put this stuff where you can find it in the dark!
- **Heating.** Central air heating systems, even if they use natural gas or propane, depend on electricity for the blower that will circulate the heated air. During a blackout, this system will not work. Areas with temperate climates allow most users to compensate with warmer clothing and the use of small propane or kerosene heaters. Wood stoves are also a popular alternative to central heating systems.
- **Refrigeration.** A refrigerator will keep things cool for a long time after power is interrupted. From the beginning, minimize the frequency and duration of opening its door to preserve its cool! As the blackout continues, consume the more perishable items first. Even a small stockpile of canned or freeze-dried foods will prove

helpful during a blackout. Unless you've arranged for a way to heat and cook food, ensure that your supply is edible "as is," or with simple re-hydrating with water.

- **Water system.** Most community water systems are designed to work for some time following a blackout, powered with huge standby generators. Private water systems built around streams, springs, and wells that use electric pumps will quit working as soon as the electricity goes off. The pressure tank will still deliver some water, so immediately fill handy containers (bottles, buckets, bowls, bathtub, etc.) before this supply is depleted. The standard household water heater is another source of 30-50 gallons of water. How will you handle toilet, shower, and sink during a blackout? Some forethought and planning will help with these processes during an extended blackout.

Other sources of electricity

Utility electricity available at the wall socket in a home or business is rated 120 Volts and 60-cycle AC. There are two ways to supply

this same specialized power in a blackout: a standby generator and a battery-powered inverter.

The standby generator:

Where the interruption of utility power even for a few hours is critical—i.e., emergency equipment and services in businesses and hospitals—a standby generator may be used to supply power. A standby generator is an engine combined with a generator.

This unit may be started manually or automatically and requires only fuel (gasoline, diesel, or propane) to operate until grid power is restored.

Homes may also use a standby generator to supply electricity during a blackout. A common arrangement is to start the backup generator from a remote control panel in the house. Some or all of the household circuitry is transferred from the utility line to the

standby generator. This process is reversed when utility service is restored.

A standby generator for homes, businesses, or hospitals is usually rated to handle only some of the existing loads. A generator large enough to handle all of the loads is big and expensive to buy, maintain, and operate. A detailed analysis of existing loads should precede the installation of any standby generator. Make a load list. This is a good place to rate loads as essential or nonessential.

Later, this helps identify circuits that will be left ON or shut OFF during generator operation.

In theory, the standby generator seems like the best way to handle blackouts. However, there are five reasons why it is less than an ideal solution: expense, fuel supply, peripherals, efficiency, and sound.

- It is a fairly expensive system for only occasional use. For a big chunk of time, the generator is not doing anything for you at all.

Standby generators designed for long life and minimal noise are more expensive than ones operating at higher rpm (3600 rpm).

- Requires fuel to run. Either you must install a large fuel tank nearby or you'll be transporting fuel cans to and from town to feed a rather thirsty beast. Weather severe enough to require generator operation is rarely the best time to travel to refill empty gas cans.
- Needs peripheral hardware to work. Remote startup. Transfer switch. Monitoring gauges. Fuel supply. A firesafe, weatherproof installation (shed?). A battery that is ready to start the generator. Add these costs to that of the generator itself.
- It is needed for even small loads. A generator powering a few loads has a much lighter load, but gobbles (inefficiently) fuel as though it's doing more work than it is. Either way, it experiences wear.

- It is noisy. This is a security issue. A standby generator lets everyone in the area know where you are. At the same time, proximity to the generator impairs one's own hearing. Bad combination. Despite these limitations, standby generators have their place. There is 100 times more available energy stored in a pound of gasoline than a pound of battery. In the short term and for big loads, the generator gives the biggest bang for the buck. The questions are: how big is your need and what's the duration of the blackout?

The battery-powered inverter:

Another way to make electricity like that supplied by a utility is through an inverter. An inverter is an electronic device that converts DC electricity into AC electricity. (DC is direct current. AC is alternating current.) The result is identical to the stuff from the utilities, even cleaner.

One source of DC electricity is a battery. Thus, an inverter can transform the DC electricity from a battery into 120V, 60-cycle AC

power. A battery is not truly a source of electricity. Rather, it is a means of storing the energy (in a chemical form) of the DC electricity supplied to it. The best sources of DC electricity are PV (Photo-Voltaic, or solar) modules, wind-electric machines, and small hydro-electric systems. More on this later.

A battery charger plugged into the utility line will also supply DC electricity to a battery. This is a popular idea. The batteries are charged and maintained at full readiness, and ready to substitute their energy for that of the utility for as long as they're able. The bigger the battery (bank of batteries), the longer the system can bridge the blackout.

These systems are common. Have you ever wondered why your phone works when a blackout occurs? Phones run on electricity, too. The phone company has a "standby" or backup system which switches ON automatically when utility power is interrupted. This is called an uninterruptible power system, or UPS.

At the heart of the UPS system is a bank of batteries that are much like the battery in your car, except bigger and heavier. Those batteries store enough energy to run an entire complex of telephone-related equipment for many hours during a blackout. When a blackout lasts longer than that, an engine-driven generator (fueled by gasoline, diesel, or propane) is started up to handle the entire load and recharge the batteries.

Until a few years ago, a small UPS system was the primary way to avoid the loss of power to during a blackout. A critical period is the time it takes to switch between utility and battery power. To avoid any glitch, early UPS systems would run the computer's inverter from the batteries full time, while utility electricity only maintained the battery pack's charge. Better electronics have improved the purity and speed of the transition time. Today, many computers are unaffected by the transition as newer "line-tie" inverters switch from utility to battery, or back, in milliseconds.

There are many applications where a split-second transition between utility and battery power is not an issue. Or where more

modest loads are dictated. Here, a simple and less expensive system—a small inverter, battery, and transfer switch—works well. The system I installed when I lived in the city was sized to power a furnace blower (and its controls), refrigerator, stereo, and four lights during an emergency.

The system was installed near the main distribution box (where the fuses or breakers are located). It involved moving the wires and breakers (to which the wires are connected) into a service box I added. With a transfer switch added between the two boxes, I could shift these three circuits between utility power or the inverter's output. This is basic electrical wiring, easy for a DIY (Do-It-Yourself) homeowner or a local electrician.

How did it work? I'd give the blackout 10 minutes before I looked for the load list. It's a map that lets me move about the house, shutting off unneeded loads on the few circuits that will be switched to the inverter. (The energy stored in the battery is the lifeblood of the backup system.)

Don't let it bleed away needlessly!) Next, I'd shut off the main utility switch, flip the transfer switch to inverter, and turn the inverter ON.

A home UPS system

The simplest backup system is composed of two major components—a battery and an inverter.

Batteries and inverters come in all shapes and sizes. Select carefully and they will serve you well.

The important characteristics of a battery are voltage (V), capacity (Ah), and design cycle.

1. Voltage. Common battery voltages are 6-Volt and 12-volt (hereafter, 6V and 12V). Large battery banks will employ individual 2V cells with massive capacities.

2. Battery capacity. Battery capacity is rated in Ah (Amp-hours) or cold-cranking amps (useless for our purposes). The Ah rating is helpful in describing the amount of energy the battery can hold.

3. Design cycle. Batteries are of two types: SLI and deep cycle. (A cycle is a discharge and full recharge.) A SLI (starting-lighting-ignition) battery is used in a car to start the engine—a fairly shallow cycle—and is immediately recharged by the engine's generator. Deep cycle batteries are used in applications where the battery's energy may be nearly depleted—a deep cycle—in use. This process will damage a SLI battery internally and eventually result in its failure.

12V vs 6V batteries

The smallest deep-cycle battery you might use for an inverter is rated 12V and 110Ah. These are used in boats, trolling motors, and RVs. At 50-70 pounds, this battery is about as much as a healthy person can carry and maneuver in a confined space. To

increase the capacity of this system, you “parallel” a second battery with the first.

To parallel a battery (same voltage only, please!), make connections positive-to-positive and negative-to negative for both batteries and load. The voltage will stay the same; in this case, 12V. At any time later, you can increase the system’s capacity (the rate or duration of power delivery) by adding batteries of the same voltage, even if they have different capacities.

A better building block in a battery bank for inverter operation is the 6V, 220Ah battery used in golf cars. It has half the voltage, yet twice the Ah of a 12V battery of the same size and weight. So, they have the same “energy density.”

To supply the 12V electricity our inverter needs, two 6V batteries are connected in series (Fig. 2) like dry cells in a flashlight, with ONE wire connecting the positive of one battery to the negative of the other. (A novice may try to connect the other two posts together, which results in a very hazardous short-circuit.) The

result of the series wiring is a new, bigger battery of 12V with the remaining posts, positive and negative, connected to the system in the same way as would be any 12V battery.

Theoretically, pound for pound, two 12V batteries in parallel will equal the capacity of two 6V batteries in series. In reality, a 6V battery is tougher— thicker plates, fewer cells to water, and greater tolerance to deep cycling and cold weather—than a 12V battery, resulting in a longer service life for almost any application.

Expect to pay \$70-85 for a 6V, deep-cycle golf car battery (or equivalent). You'll need them in pairs for inverter operation at 12V.

Inverter features and ratings

Today's inverters serve two critical functions. First and primary, they convert the battery's output (low-voltage DC) to a form that your household can use (120 or 240 volts AC, 60 cycles).

Second—and most desirable for standby generator or utility interaction—is the internal battery charger option. A battery charger’s operation (DC-to-AC) is simply the reverse of an inverter’s operation (AC-to-DC). When combined in one box, the inverter and battery charger share (use) the same electronic hardware. In this way, utility electricity stores itself in a battery which, in a blackout, will release the energy, powering an inverter to make 120V, 60-cycle AC.

The battery and inverter must be “matched” to each other and to the loads you expect them to power.

Appliances, lights, and tools are referred to as “loads.” Each “load” has its own power (consumption) rating. You may have heard the term “wattage.” This is an expression of the RATE at which a load uses electricity.

Generally, lights and radios are small loads while refrigerators, motors, and toasters are big loads. The effect of loads is accumulative. That is, if you operate more than one load at one time, the total load is the addition of all those wattages. The

power consumed by even one small light all night might be greater than that of a toaster operating for a few minutes.

In an emergency, you must reduce the loads the battery/inverter unit will power. The faster you use the energy stored in the batteries, the sooner you'll have a "second" blackout! Make sense? In a blackout, you become the power company, responsible for rationing both the rate and quantity of expected household needs for a specific time period.

Inverters have voltage and wattage ratings.

1. Voltage. The voltage ratings are divided into input and output. The input voltage is the DC voltage of the battery bank. Inverters exist to handle DC voltages of 12V, 24V, 32V, 48V, or 120V. The output voltage of the inverter is the 60-cycle AC voltage. It may be 120V (commercial) or 220V (industrial), or both.

2. **Wattage.** Wattage ratings of inverters range from 50-4,000 Watts(4kW) or larger. What wattage works for you? Here's a handy rule-of-thumb.

- a. The minimum wattage rating of the inverter is determined by the largest single load you expect it to power.
- b. The maximum wattage rating of the inverter is the largest combination of loads you want it to power simultaneously.

For example, if you had loads of 50 watts, 120 watts, 220 watts, 1200 watts, and 1400 watts, the inverter rating could be as low as 1400 watts (for the biggest single load) or as high as 2940 watts (for all of these loads.)

High-power inverters are expensive and require more battery capacity. Smart owners balance this situation by avoiding simultaneous use of heavy loads. In this example, then, selecting a

2000-watt inverter would handle everything else if the operator avoids using the two biggest loads simultaneously.

The price tag of a small UPS system is well within the reach of many homeowners. Inverters average a dollar a watt and batteries (lead-acid type) about a dollar a pound. A battery/inverter system is virtually maintenance-free and tucks away on a shelf in the garage or carport, ready to work when the blackout comes. Fortunately, your investment in this system has a second success. It is the core of a system that enables you, when you're ready and able, to tap the renewable energy sources—solar, wind, and hydro—all around you.

A no-inverter DC system

Utility power, in the form of 120VAC, 60Hz, is very specialized power. In a blackout, you may have less need for it than you might think. It is well known that a car or truck is useful in emergencies for the radio, light, heat, and shelter it offers. Without

the engine running, there is enough capacity in vehicle's 12V battery to power lights, radio, and the horn for some time. Periodic engine startup adds heat to the equation and recharges the battery, too!

Similarly, a stand-alone 12V battery pack located in the garage or home may be kept on charge (with a battery charger) until utility power fails and its stored energy is needed "as is," at 12V. This does not mean that you can power the same 120V loads as an inverter will.

The RV (recreational vehicle), automotive, and marine markets offer almost any type of appliance, motor, tool, pump, and light that will work directly from 12 volts DC. For example, several high-efficiency 12V fluorescent lights will provide 20-40 hours of welcome light from one automotive-size battery. I can think of nothing more reassuring in the darkness, particularly when a storm is raging, than the steady glow of a lamp.

How do you wire up a 12V system to be blackout-ready? For occasional use, clamp-type lamps and several lengths of extension cords may be connected together to distribute light through a dwelling. This assembly can be coiled up and put away until a blackout occurs. A more permanent solution is to dedicate an electric circuit to 12V use. Existing household circuitry rarely adapts easily to a dedicated usage (unless one is still building one's home). Here, a well-planned layout and one standard roll of Romex wire will add a 12V circuit to any home, shop, or building for lights and a radio.

Living beyond the grid

Most RE (renewable energy) systems are based around 6V and 12V storage batteries. The simplest RE systems use a solar module, one or two batteries, a few 12V lights, and a 12V radio. Except for the PV module, this is identical to the system (described above) to supply power during a blackout. Becoming blackout-ready, then, is a step in the direction of becoming energy independent.

RE systems are generally located “beyond the grid.”

The cost of bringing in utility service even a mile is often more expensive than investing in a system that is utility-free. RE technology has focused on being modular. This makes it simple to add more capacity, and to move and re-install the system.

There are energy sources other than PV modules worthy of your attention: wind and water. Wind-electric machines and small hydro-electric turbines are also viable energy producers. A multi-source system is smart for three reasons:

1. Seasonally, wind and water sources of energy are complementary with solar-generated power.
2. Solar, wind, and water system hardware is designed to supply low-voltage DC, particularly 12V and 24V.
3. A system designed around one source readily accommodates additional sources. The systems are more similar than different.

Therefore, the battery bank, distribution and fusing panels, and monitoring equipment are virtually the same and are shared by the different sources.

Putting together a backup or RE system is also a good way to learn the basics of electricity itself (i.e., volts, amps, watts, and amp-hours). I believe this is essential if one is going to rely on electricity for anything. With this knowledge comes an appreciation for how energy moves and changes, and how it can be harnessed to fill your needs.

Beyond a blackout

Preparing for something worse or longer than a normal blackout is a frightening prospect. I avoid being overwhelmed by the sheer immensity of the topic by dividing the issues into two phases: basics and preparation.

Basics:

Basics represent the checklist of life. What does a human being need to survive, short and long term? Air, water, shelter, and food.

Air: Few think much about breathing until they can't.

Remedies that take longer than three minutes are of little value.

Shelters must remain tied to the atmosphere directly. If there are airborne pollutants (smoke, ash, etc.), filters will be needed to breathe without risk of injury.

Water: Humans can live only three days without water. See that you store some or have access to it. Water is easily contaminated. Figure out a way to purify it. Drink and cook with pure water or risk illness.

Shelter: Human beings are amazingly manipulative of their environment, yet remain vulnerable to it in crisis. Shelter holds back the extremes of heat and cold, offers dryness, and feels safer for sleeping.

Energy: While we manipulate energy in our home, workplace, and car on many levels every day, it is all artificially generated. When that source is lost, the first job is to conserve it, in whatever form it is available. With any prolonged interruption of transportation or utility services in crisis, stockpiles of fuels like gasoline, diesel, and kerosene will be depleted or prohibitively expensive.

Food: Humans can live about a week without food, less in cold weather and limited water. In a mild emergency, stockpiling food, even enough for 5-7 days, saves having to forage, hunt, buy, barter, or trade for it. Or worse. Hunger strips away the resolve of people unaccustomed to its grip. Foodstuffs in most cities would disappear in a few days during a real crisis.

Preparation:

As one becomes more self-reliant, there is less dependence on (or need to buy) water, electricity, food, and fuels. Transportation needs also decline, allowing you more time to live and work at

home. Coincidentally, this process prepares oneself for short and long-term disasters.

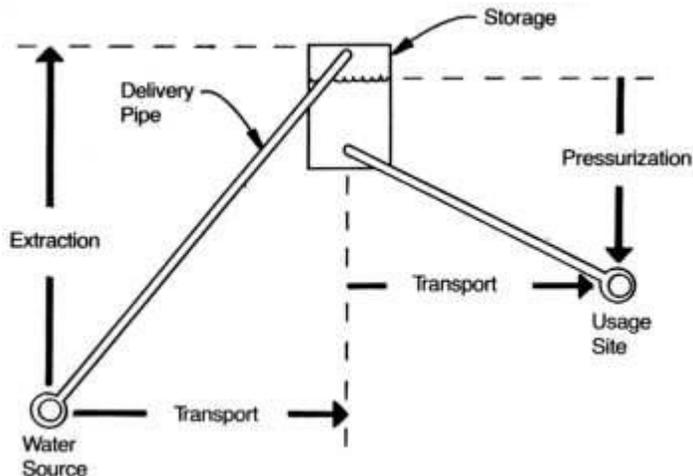
This design of solar water heater exposes the tanks directly to the sun in an insulated box.

Here are some additional thoughts on preparations for water, food, energy, heat, lighting, motors, electronics, communication, and transportation.

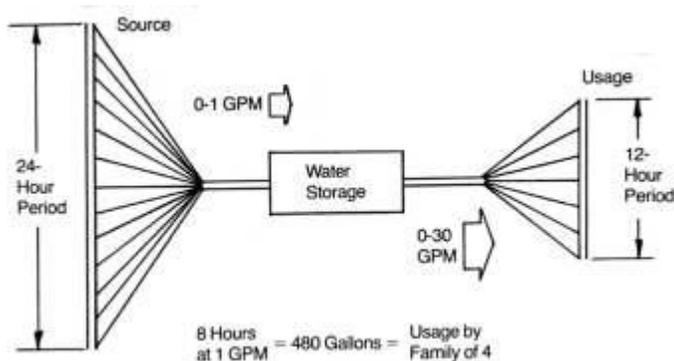
Water: In a crisis, life is water. If your shelter—home, building, garage, cabin, RV, camper, tent, tipi, tarp, or cave—is connected to the town or city supply, your backup plan is to fill everything you can as soon as you can. If you can't develop your own source, prepare some way to store water in 5-55 gallon plastic containers, or plastic, wood, or steel tanks.

If you plan to develop a water source, or already have, make certain that your system is not completely dependent on utility or generator power. The process of water usage can be broken

down into four areas: extraction, transport, storage, and pressurization (Fig. 3).

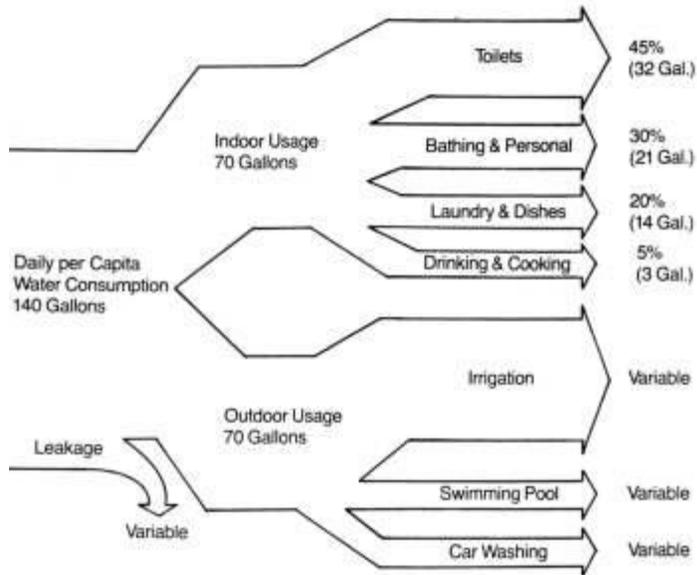


Treat them as separate issues to maximize the versatility of the system. A low-yield water source quickly accumulates enough water to handle a standard household (Fig. 4).



There are low-power, low-voltage, and energy-efficient alternatives to the standard submersible pump. These can be piggybacked onto existing systems or work alone. PV modules powering a 12V or 24V pump (no battery) have seriously challenged wind-powered pumps in unattended operation, like livestock watering, in the past decade. Most renewable energy systems use something similar.

Water you waste also wastes the energy invested to get the water to you. A more active conservation method makes multiple use of the water. A “gray-water” system often doubles the usefulness of the water supply (Fig 5). Cooking, drinking and rinsing are the purest uses.



Garden, clothes washing, and toilet are secondary uses. A plan and a bit of plumbing will help with this.

There are several books on gray-water systems.

Look at rainfall collection, cisterns, and pools as additional sources and storage methods.

Food: Food is one of the first concerns anyone will have in a crisis. Food issues revolve around supply, preservation, and cooking.

1. Supply is what you start with, if you don't grow your own. A stockpile, however small, is a good idea. Trading work or goods

with people who farm and garden also works. A growing space and some seed are the best investment. Learn what to do with the seeds, and how and when to use them. Greenhouses and growframes provide vital protection against the elements, insects, and foraging animals and otherwise assist with year-round growing.

2. Preservation recognizes that food must be preserved against spoilage and infestation.

Standard refrigerators and freezers work when there is abundant electricity. In an RE system, they hog energy. A high-efficiency, low-voltage refrigerator is expensive, yet rugged. More importantly, it frees up an appreciable chunk of energy that would be otherwise generated, stored, and inverted—only to be wasted.

There are alternatives to refrigerators—canning and dehydrating, selective harvesting, and earth storage (i.e., a root cellar). Several good designs of solar dehydrators exist. Using one or more of these techniques further reduces the load on, or the need for, a refrigerator.

3. Cooking. It takes energy to cook food, particularly grains and vegetables. How much? Of what type? Solar cookers are a good bet if you're home. A 24-hour solar-powered oven is possible. A parabolic tray of less than 100 square feet can heat natural oils in excess of 350 degrees F. (100 degrees F short of their flash point) and store a sufficient quantity to keep the oven of uniform temperature throughout a 24-hour period. Use gas or wood heat to back up this system.

Energy: Your home is probably supplied with energy in the form of electricity and natural gas.

Rural homes may use wood energy and propane. These energy "sources" are converted into only a few useful forms: heat, light, mechanical motion, and sound (stereo and radio).

Heat: Heat is a cherished form of energy and the biggest load in the home. Space heating. Water heating. Cooking. Dishwashing. Clothes washing. Both refrigerators and air conditioners are heat pumps.

Good designs of solar collectors exist to handle these heating tasks. While designing a home to use solar energy is optimal, many homes can be retrofitted to use it effectively. Thermal mass— water, concrete and rock—will store solar energy for nighttime and storms. Save wood and other fuels for really bad weather. The perceived need for air conditioning and massive heaters is a cover up for poor design, sloppy construction, and cheap materials. Good insulation is a must— floor, walls, and ceiling—to avoid heat loss in winter and heat gain in summer.

A good understanding of how heat moves (radiated, conducted, and convected) and what happens to radiated heat (transmitted, absorbed, and reflected) helps collect, contain, store, use, and release it .

Lighting: Lighting is essential for moving about at night, or in dark places. Still, night is for sleep, even in emergencies. Rest is important in survival. And sleeping saves light! Incandescents, fluorescents, LEDs, and oil lamps all have value in lighting.

1. Incandescents, like standard household 120V bulbs and spotlights, gobble energy. Reserve their use to short durations. 12V automotive (turn signal type incandescent) bulbs are inexpensive, work directly on 12VDC, and are low-wattage. Still, use them sparingly.
2. Fluorescents, particularly those that are high-frequency (20KHz or above) are efficient and long lived.
3. LEDs are light-emitting diodes that operate at extremely low power. LEDs may be grouped together to increase voltage and light intensity. They're expensive but have a service life hundreds of times longer than incandescents.
4. Oil lamps will burn natural oils that may be pressed from many types of plants. Motors: Motors convert electricity into mechanical motion. Motors power appliances in the home and tools in the shop. Pumps, fans, hair dryers, coffee grinders, juicers, turntables, tape decks, CD players, vacuum cleaners, computers, answering machines, and electric can openers use AC or DC motors.

High-wattage motors are difficult to power with low-voltage DC directly. Use an inverter or generator, as needed. Low-voltage DC motors may be substituted for AC ones under 2 HP. Or seek their 12V DC counterparts. Of course, manual tools don't need electricity to work.

Electronics: Electronic devices may be divided into two categories: high voltage and low voltage. The bigger and heavier the electronics, the more likely the need for 120V, 60-cycle AC. This includes the family stereo system, computers and peripherals, printers, television, and microwave ovens. Inverters and generators will be needed to power these units.

Light-duty electronics work around low-voltage DC, often below 12V. This includes remote phones, answering machines, portable radios, calculators, and portable CD and tape players.

Look for a black module that plugs into the wall receptacle. The other end plugs into a DC input jack. DC input jacks may also be found on battery-powered units.

With a suitable DC-DC converter (or a dropping resistor), these electronic gizmos can be directly powered from a 12V car battery. (With a small modification, the jack can be re-wired to also recharge NiCads while they're in the radio.) Note the voltage printed near the jack to find the unit's voltage. Or count the number of cells (batteries) the unit contains and multiply by 1.5V to calculate the voltage. Or read the rating on the black module that plugs into the wall. This will help select the dropping resistor or converter setting.

Most electronic devices are polarity sensitive. By law, manufacturers are required to show the polarity of DC inputs, usually with a symbol. Wire the jacks and plugs accordingly.

Small 12V B&W TV sets may also prove handy, providing local coverage of a crisis. (Sorry, 12V color TVs gobble energy. Avoid using them.) These and other 12V devices often use a cigarette lighter plug (like the one that plugs into the car dash). If your vehicle doesn't have one, buy a lighter receptacle from an RV or

renewables dealer. It can be clamped to the car battery posts or hardwired into the vehicle.

Communication: Details of what is happening beyond your own influence during a crisis is useful and, perhaps, crucial. In a blackout, the AM-FM radio in a car or truck may be the only communication at your disposal. At low volume, a radio will work for many days on just the car battery. You may need to position the vehicle (and antenna) away from buildings to get good reception. The news may not be reassuring if you're expecting help, but it will help you make better guesses or decisions about what you can and can't do.

Battery-powered, multi-band radios or boomboxes that use dry cells are equally good. With rechargeable cells (i.e., with NiCads) installed, there is no end to their useful service life. The cells can be recharged from renewable energy sources or even the 12V battery in a car. Note the actual voltage, use a converter or dropping resistor, and observe polarity. At low volume (or with

earphones), these radios use only a tiny amount of energy in operation.

Transceivers, ham radio sets, walkie talkies, and CB (Citizen Band) radios are all useful, particularly for communities.

Understand the power requirements to ensure that you can meet them. As well, recognize that sophisticated radio gear doesn't mean more effective communication. The semiconductor junctions in transistors and chips are extremely vulnerable to EMP (electromagnetic pulses) generated at high altitudes by both nuclear weapons and meteor strikes. The more complex something is, the more there is that can go wrong with it.

Transportation: Transportation may be adversely affected by crisis. Roads blocked with debris or other vehicles, bridges out, power lines down—these are common themes in a disaster.

Owning a 4WD vehicle helps but it will need fuel, oil, tires, and parts to operate.

Vehicles converted to electric propulsion have an advantage over gas engines. There are only a few sources for gasoline. An electric vehicle (EV) is “fueled” by electricity from utility power, a standby generator, and renewable energy systems (solar, wind, or hydro). An EV has an additional advantage over vehicles with engines: it is silent in operation.

It may be easier to get around with motorcycles (noisy unless electric) and bicycles (mountain-type).

Closer to home, carts, wagons, wheelbarrows, and garden carts will help with everyday work or emergencies. Again, with self-reliance, there is simply less need for transportation.