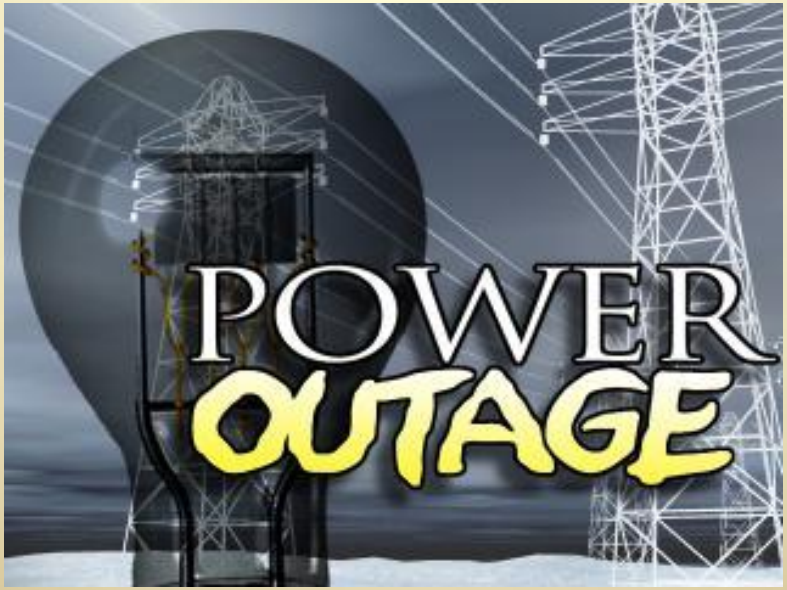
EMERGENCY PREPAREDNESS WORKSHOP:

Alternative Energy

Presented By: Jon Sherman

Disclaimer

- The focus and direction of this presentation is to help families prepare in a way to get through an extended power outage more so than instructions for off-grid living.



Introduction

- We use Electricity (grid juice) everyday to power our lives.
- It is very reliable, which is why we have grown to rely on it as one of our sole sources of power.
- Occasionally, the power can go out due to storms or other disasters.
- Usually, these outages are brief.
  Other times they can last much longer.
- During these long outages, we may need a backup power source to continue our day-to-day lives.

Energy

- Let's start by defining some of our most common energy needs:
  - Light
  - Heat
  - Air Conditioning
  - Cooking
  - Refrigeration
  - Entertainment
  - Communications
  - Transportation

Energy Conservation

- When the power goes out. Sacrifices most be made. It isn't practical to assume you will be able to power your life in the same way while using backup power, as when the power was on.
- You won't be trying to power your entire house or cook using your large kitchen appliances.
- Families can reduce needed resources by limiting the numbers of rooms used, and the types of activities performed during the outage.

Energy Conservation

- More important and practical than having a backup supply of power, is also finding ways to reduce or eliminate the need for that power during an outage.
- We will touch on this idea as we discuss each energy need.


LIGHT

Needs for Light

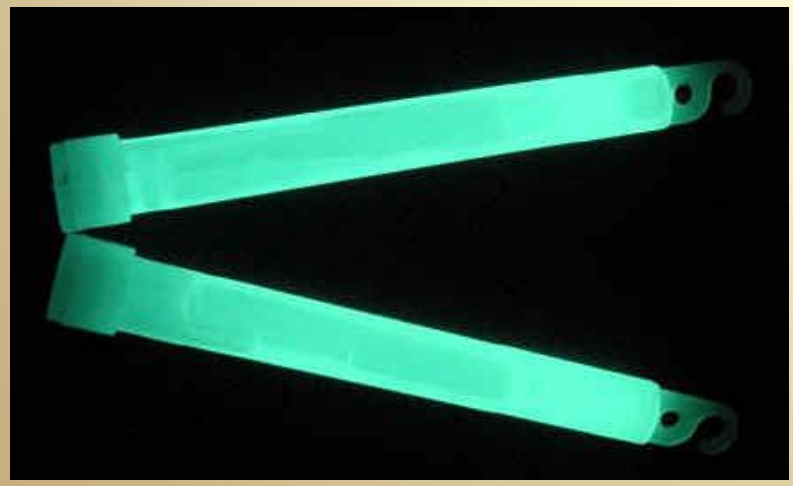
- Lighting for large areas in each room of your home.
- Bright lighting for smaller areas.
- Comfort/Night-Lights for Children.

Reducing Needs for Light

- Wake up at dawn, go to bed earlier. Do most duties during the daylight hours. Save relaxing, reading and games for the evening hours.
- Reduce the rooms used during the evening hours. All evening activities could take place in one central room.
- Use of LED bulbs are much more efficient than other bulbs. LED bulbs will allow your batteries to last much longer.

Light for Remaining Needs

- Comfort/Night-Lights for Children.
  - Chemical Light Sticks are a great choice to solve this need. Children often get scared in a power outage and something to comfort them is invaluable. They run about $1.00 to $1.25 each and last from 8-12 hours. Buy several to last several nights of no power.



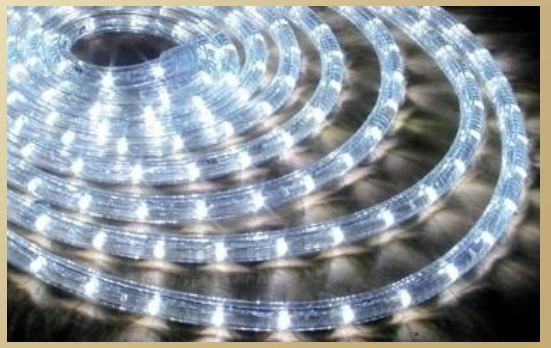
Light for Remaining Needs

- Area Light
  - Solar Powered Lanterns can charge each day and run at night for thousands of nights.
  - Kerosene lanterns, with enough fuel can provide you with light for weeks.
  - Candles can provide small amounts of light and heat to a small room.

Light for Remaining Needs

- Area Light
  - Solar Powered Yard Lights.
  - LED Christmas or Rope Lights and Backup Power.

(Battery can be charged using multiple methods)



Sources of Light for Remaining Needs

- Small Areas
  - Small (LED) flashlights are very efficient.
  - Buy flashlights that use standard sized batteries so they are easier to find and replace.
  - Buy Rechargeable batteries, including extras so you always have a supply of charged batteries available.
  - You can use solar panels or other alternative energy source to keep a constant supply of charged batteries for your small electronics.
  - Crank (Dynamo) and Faraday Flashlights have their uses as well.


HEAT

Needs for Heat

- Warming your home during the colder months.

Reducing Needs for Heat

- In the central deserts of Arizona, we can practically do without central heating in the winter.
- Reduce the number of rooms occupied during the colder hours of the day and night.
- Insulate the rooms with foam, blankets, aluminum foil on windows, etc…
- Dress warm. Use extra blankets at night.
- People in colder climates should research "Foam Clothing".
- Heaters are "Energy Hogs". Avoid using them as much as possible.

Sources of Heat For Remaining Needs

- Portable Indoor Propane Heaters
  - Propane can store almost indefinitely.
  - Operating time (High/Low): Up to 3 to 6 hours on a 1 lb. cylinder. Up to 48 to 110 hours on a 20 lb. cylinder.
- Candles:
  - Not very effective but suitable for very small areas.

Sources of Heat For Remaining Needs

- Kerosene Heaters
  - Kerosene can be stored safely for years without the loss of potency.
  - Using an efficient kerosene heater, 1 gallon could last 2-4 nights of use depending on how cold it is outside.

Sources of Heat For Remaining Needs

- Wood
  - Not very heat-efficient but very cheap if you have access to free firewood.
  - Efficiency greatly increased by using a pot bellied stove.
  - Make sure indoor wood-fires have sufficient escape for smoke and gases.

Air Conditioning

Needs for A/C

- A/C is a comfort item not a necessity. (Despite how badly we feel we need it.)
- Running an A/C is an “Energy Hog”. It is not practical running a home A/C from your backup power supply.

Reducing Needs for A/C

- Keep heat from building up inside the home.
- Let warm air out of the house during cooler evening hours and bring cool air in.
- Find ways to reduce the generation of internal heat.
- Circulate air using a 12 volt fan (Solar Power).

Reducing Needs for A/C

- Soak and ring out bed sheets before you go to sleep, they will keep you cool throughout the night.
- A bed sheet hung at doorways or windows where there is a breeze will help cool a room.

Sources for A/C

- 12 Volt DC Portable Swamp Cooler
- 12 Volt DC
- .8 Amps – 1.7 Amps
- 11.3 Watts – 21.4 Watts
- $297.00

www.swampy.net

Cooking

Needs for Cooking

- No power means…no using the oven, stove tops and microwaves. (or eating-out if the outage is widespread)
- Running these energy hogging appliances off of a solar-charged battery bank is not practical.
- Ovens fueled by natural gas will still function if just the power is out.

Reducing Needs for Cooking

- 90-Day Food Supply
  - Store a 90-Day Supply of Food that requires no refrigeration and little to no cooking.
  - Following this principle means you should be able to last 3 months with little or no cooking necessary.
  - MRE's, Canned Ravioli and Canned Chili for example can be eaten with no cooking what-so-ever.

Solving your Cooking Needs

- Solar Ovens
  - This is a must-have!!!
  - The Sun provides Free Fuel. Use it as much as possible.

Solving your Cooking Needs

- Charcoal
  - A Year's supply of Charcoal (about 300 lbs.) will cost you between $100 and $150.
  - 300lbs. of charcoal will fit in 11-12 5 gallon buckets.
  - Use an efficient stove like a Volcano Stove to make your charcoal last longer.

Solving your Cooking Needs

- Other Simple Cooking Methods:
  - Rocket Stove (Fuel = twigs)
  - Alcohol Stoves (Possible Indoor Use)
  - Wonderbox (Heat Retention Cooker)

Solving your Cooking Needs

- Other Simple Cooking Methods:
  - Propane Stoves or Grills (Propane has a very long Shelf Life)
  - Kerosene Stove (Kerosene has a Long Shelf Life)


Refrigeration

Needs for Refrigeration

- Prevent Spoilage of Fresh Foods.
- Certain Medicines Require Refrigeration.

Reducing Needs for Refrigeration

- 90-Day Food Supply
  - Store a 90-Day Supply of Food that requires no refrigeration and little to no cooking.
  - Following this principle means you should be able to last 3 months with no food related refrigeration necessary.
  - MRE's, Canned Ravioli and Canned Chili for example can be stored with no refrigeration what-so-ever.

Reducing Needs for Refrigeration

- Food stored in your fridge should be consumed first following a power outage. Frozen foods in your freezer should be consumed next.
- This should get you through the first 2-3 days.
- Extra thawed meat from your freezer can be cooked or dried to last longer.

Solving your Refrigeration Needs

- Generators can be used to keep your refrigerator cool but a 3,500 Watt Generator will use 3 gallons of gas every 4 hours at 50% consumption.

- Engel or EdgeStar Fridge/Freezers
  - Efficient Compressors
  - Runs on 12 Volt DC (or 110V AC Adapter
  - 14 Quarts (12 Cans) – 84 Quarts (118 Cans)
  - $399-$1,100
  - 0.5 – 3.9 Amps (6-45 Watts)
  - About 2 weeks on a deep cycle battery.
  - Longer if batteries recharged by solar panels.

Entertainment

Needs for (Powered) Entertainment

- TV, Video Games, Movies, Portable Electronics, Computers, Etc…
- These products are fun and provide, at times, a much deserved distraction from the day-to-day stresses of life.

Reducing Needs for (Powered) Entertainment

- Powered entertainment devices are certainly a luxury when there is no electricity…and you are trying to generate your own.
- It will be more important in rough times, to maintain a sense of normalcy and continue to have fun, comforting family time.
- Consider non-powered entertainment such as board games, sports or playing musical instruments.

Powered Entertainment

- With solar panels or generators setup to run a small battery recharger, portable electronics and other low-draw electronics can continue to be used.
- This may help add comfort to children during a potentially scary experience.

Communications

Needs for Communications

- In any emergency, even extended power outages, sending and receiving information will be very important.
- During a power outage, you won't be able to turn on the TV and listen to the nightly news.
- You will need a way to receive important updates on the current status of what is going on around you.
- You will also want a way to communicate with your loved ones.

Reducing Needs for Communications

- Communication is not an area you will want to ignore.
- The more means of communications you have at your disposal, the better informed you will be.
- It is hard to tell what means of communications will be operational so plan on having as many as you can.

Sources of Communications

- Hand-Crank Radio – A “must-have”. You can listen to emergency updates. Make sure it also picks up NOAA weather channels.
- Cell Phones – If the phones are down but the cell-network is up. These could be handy. Usually, if the Electricity goes down, so will the cell phone network.
- Non-AC powered telephone – A power outage does not necessarily mean the phones are down as well. Buy a phone the runs off of the power from the phone line. (No AC plug)
- Ham Radio – When all other forms of communication are inoperable, Ham Radio Works! Get a license. Get a radio. Stay Connected!


Transportation

Needs for Transportation

- If the power outage is extended and covers a large area. Businesses may be forced to shut their doors until the power is restored.
- This may mean no places to buy groceries, etc.. and no work to go to.
- You may decide to leave town to find a place where there is electricity. If so, you will need fuel to get you there.

Reducing Needs for Transportation

- Businesses closing due to lack of power will certainly help in reducing your needs for transportation.
- Besides short local visits where walking or bicycles are an option, gas-powered vehicles are virtually the sole form of viable long distance transportation.
- Until real improvement is made in the world of alt-fuel vehicles, we are stuck with gas.
- If you do buy a generator, consider buying one that uses the same fuel as you vehicle so you could use it for either (although diesel and propane store longer than gas).

Sources of Transportation

- Store gasoline.
  - Store enough to get you 1.5 – 2 tanks of gas out of town.
  - Gas starts to breakdown within 6 months so rotate it.
  - Do not store it in the garage.
  - Fuel Stabilizers such as STA-BIL will help the fuel last longer.

Let's Review

- Light – With a few supplies, such as solar lanterns, light sticks and kerosene lamps. You can last several days or even a few weeks without power.
- Heat – Insulating rooms, the use of fire places, pot bellied stoves, portable propane or kerosene heaters you can last all winter with no central heating.
- Air Conditioning – This is hard to fix, but, with some simple tricks, you can reduce the temperature in your home to "Survivable" levels.
- Cooking – Have a 90-day supply of canned/boxed food. A Solar Oven, Volcano Stove, 300lbs. of Charcoal , Rocket Stove and Wonderbox will keep you cooking for a year.

Let's Review

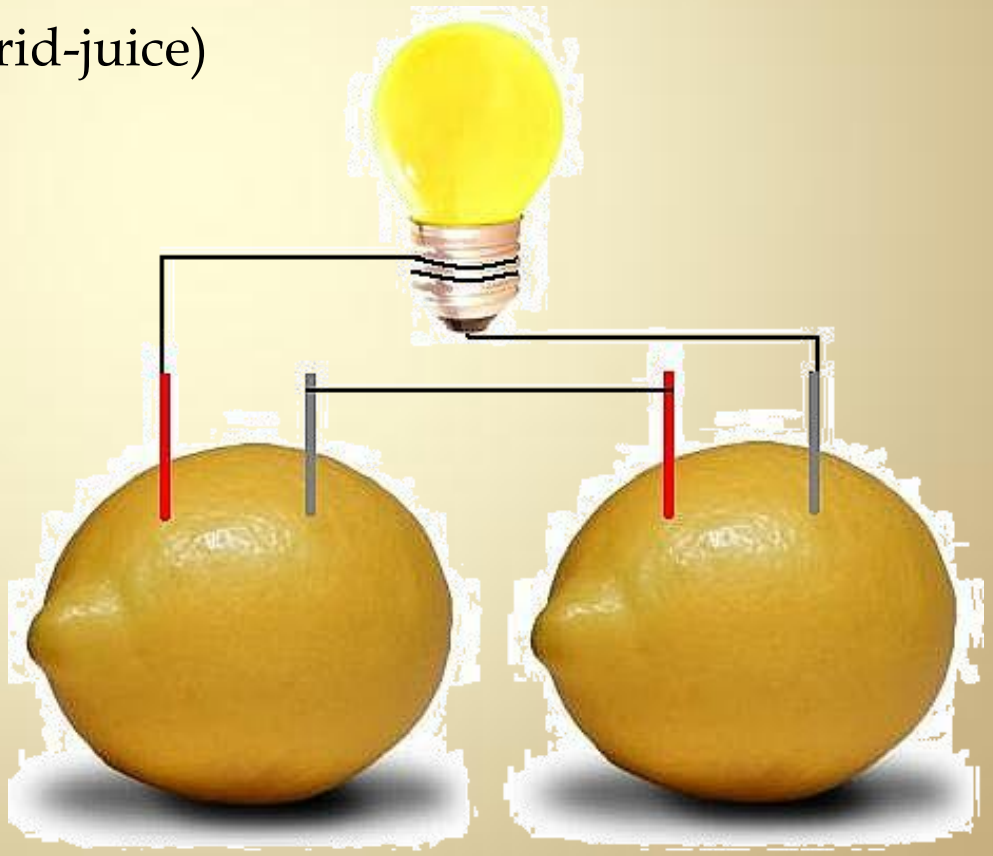
- Refrigeration – Consume fresh and frozen foods the first 2-3 days after the power goes out. Your canned/boxed 90-Day Food Supply will not need refrigeration. If you need to keep medicines cold, buy an efficient 12V Fridge and Deep Cycle Battery.
- Entertainment – Learn to do it the old fashion way. Play board games and play musical instruments.
- Communications – Crank Radios, Ham Radios, Phone-line powered phones. Small solar battery chargers can help a lot here.
- Transportation – Store enough fuel to evacuate. Enough to fill-up your vehicle 1.5-2 times.

Let's Review

- For the most part, in all areas we reviewed, if planned for properly, alternative sources of energy such as: generators, solar power, wind power, hydro power, etc… are not necessary for an extended power outage. This applies to outages that can last up to 3 months.
- The most likely exception would be a simple system to charge batteries to keep small electronics in operation….or power to run medical devices such as for breathing treatments for asthma sufferers.
- Make sure you have all of these basics covered before you invest in expensive systems of alternative energy production. (medical needs are a possible exception)

Alternative Energy

- Let's assume you have prepared for extended power outages and you are now interested in off-grid living or you've decided you can't live without playing your Xbox or using a curling iron during an outage.
- Here are some Methods of Alternative Energy :
- Battery Banks (charged by grid-juice)
- Wind Power
- Solar Power
- Generators
- Human Power



Battery Bank

- Batteries can store a lot of energy that can be used when you need it. If you are just getting started with a solar system, you may want to begin with the batteries. Several deep cycle industrial batteries will be needed to store the electricity you collect from your solar panels (or wind turbine, etc.)
- Until you have your system together, you can keep your batteries charged using your home electricity. This way you always have your batteries charged. Those with portable solar or wind units may choose to leave their systems put-away until they need them and reduce aging and wear and tear.

Xantrex Power Supply

Runs Fridge for 4 Hrs.

Batteries

- Batteries are most commonly divided into 3 categories. Starting, Deep-Cycle and Marine.
- Starting Batteries have a large available starting current. They are used to start engines.
- Deep-Cycle Batteries have less instant power but can be used much longer for lower-draw applications. They can also be discharged up to 80% and recharged many times. Deep-Cycle Batteries are best for solar and wind powered system applications.
- Marine Batteries are typically a hybrid between Starting and Deep-Cycle batteries. Unfortunately, it is hard to determine what you are really getting here.

Great Website with Deep Cycle Battery Info:

http://www.windsun.com/Batteries/Battery_FAQ.htm

Wind Power

- Urban or rooftop mounted wind turbines have proven to be very poor performers.
- Free standing turbines produce about 6x as much as rooftop mounted units. Ideally:
  - Rotors should be 12 feet or longer in diameter.
  - Towers range from 30-70 feet high.

Source:

http://www.wind-works.org/SmallTurbines/BritainsEnergySavingsTrustFindsSmallTurbinesPerformPoorlyinTests.html

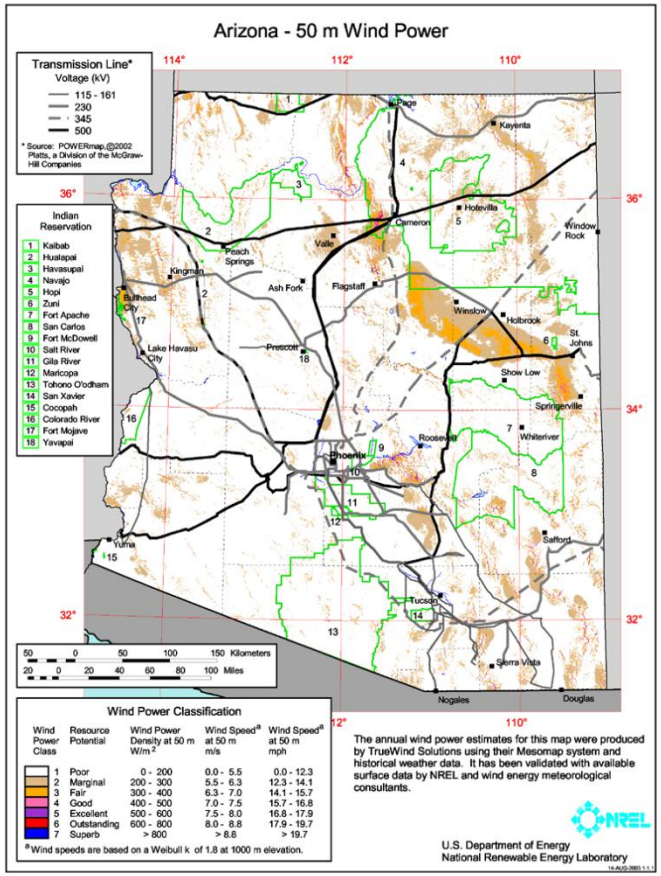
Wind Power

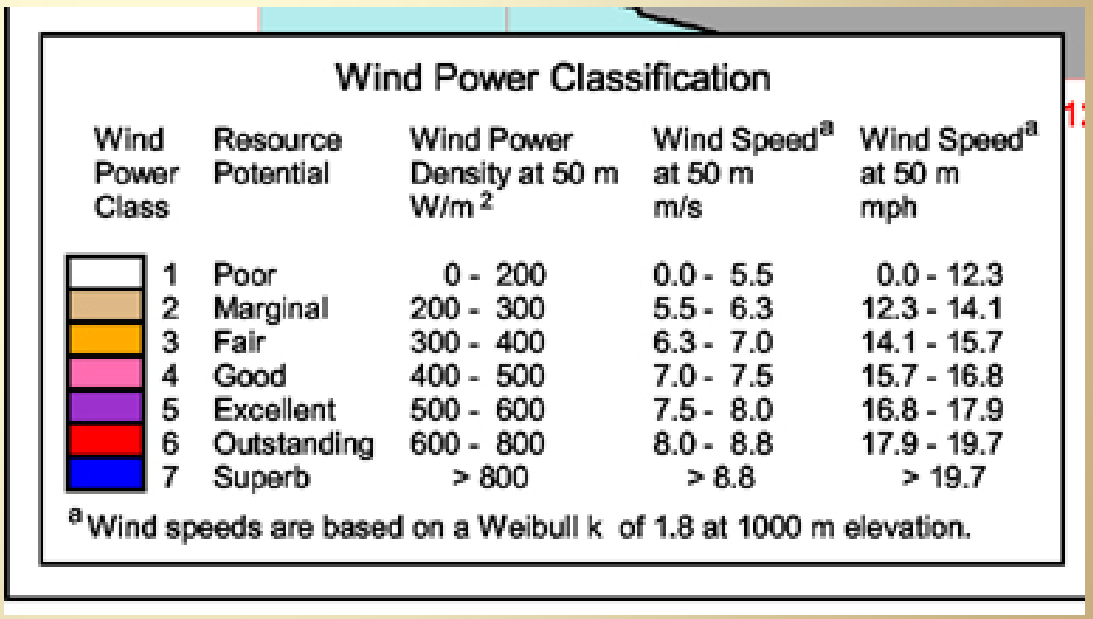
- The annual output of a wind turbine depends on four parameters:
  - The size of the turbine
  - The average wind speed at 10 meters
  - The height of the pole
  - The type of ground surface
- Small wind turbines suffer from ground turbulence.
- This means that the wind is slowed down by trees, houses, etc.
- Not only do these objects brake the speed of the wind, they will also cause turbulence, which will reduce the performance of the turbine.
- You should use a pole that is as high as possible. This will keep the head of the wind turbine out of the turbulence below.
- A general rule of thumb is that the wind mill should be at least two times higher than the surrounding objects, especially from the prevailing wind directions.

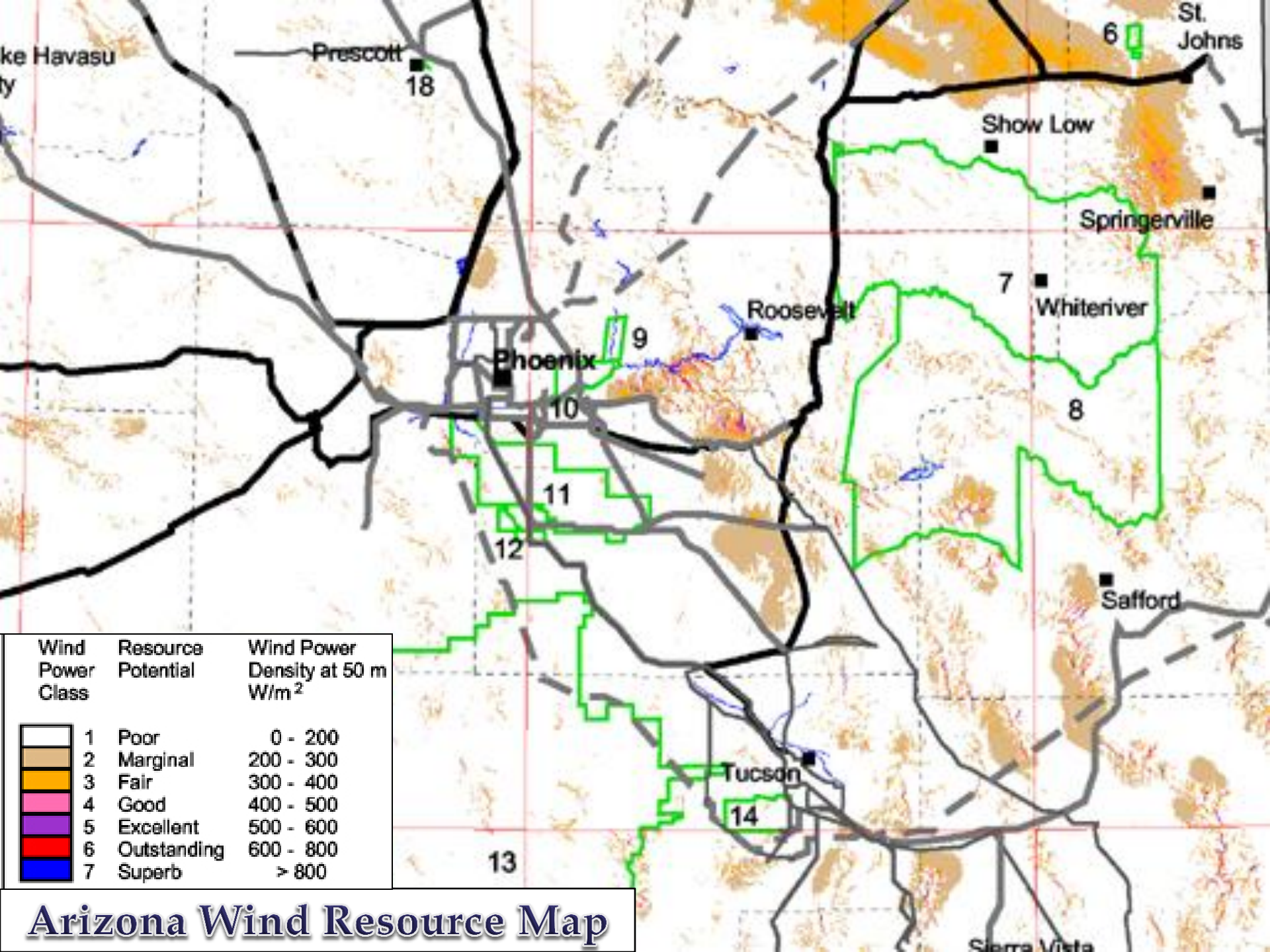
Wind Power

Wind Resource Maps for the U.S.

http://www.windpoweringamerica.gov/wind_maps.asp







Arizona Wind Resource Map

Generators

•Gas or diesel powered generators give the most power per dollar performance for large electrical loads for relatively short periods.

•Gas powered generators will consume on average ¼ gallon of fuel per kilowatt hour, and roughly 1/8 of a gallon for diesel generators.

•Diesel generators cost 2-3 times more than gasoline generators.

- Propane powered generators are more expensive than gas and diesel generators. Propane generators consume more fuel but fuel storage is much longer.

Selecting Generators

- Answer these questions:
- Determine your needs, What do you want to run in an emergency and why?
- Do you want the generator to operate part or all of your home devices?
- Identify the devices the generator will need to power.
- Determine the starting and running wattage for each device you plan to use frequently.
- Keep in mind that you will not operate everything at the same time. During emergencies you will only operate just the devices you need to survive & keep you comfortable.
- You should size the generator 20-25% over the size you determine your needs to be. This will allow room for future growth.

Selecting Generators

Selecting the Power of your Generator

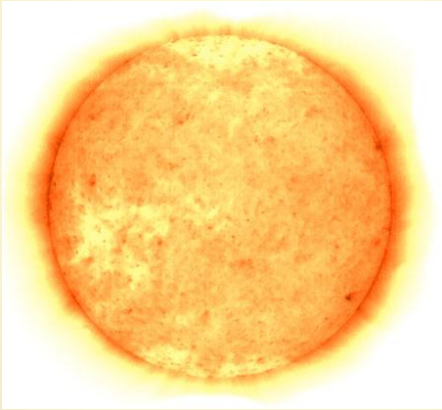
Generator Wattage Worksheet

Device	Continuous Wattage	Extra Peak Wattage
Light Bulb (watts times # of bulbs)	60 x 10 = 600	0
Microwave Oven 1,000 Watts	1,000	0
Radio	100	0
Refrigerator/Freezer	600	2,100
Air Conditioning (Central) 10,000 BTUs	1,500	3,000
Laptop Computer	600	0
Air Compressor 1 Horsepower	1,500	2,900

Total Continuous Wattage	5,900	3,000	Highest Peak Wattage
		+	
		5,900	
Required Peak Wattage		8,900	

Solar Power

- Here in the Arizona Desert, Solar is our logical choice for alternative renewable energy.
- Let's see how we compare to the rest of the nation…

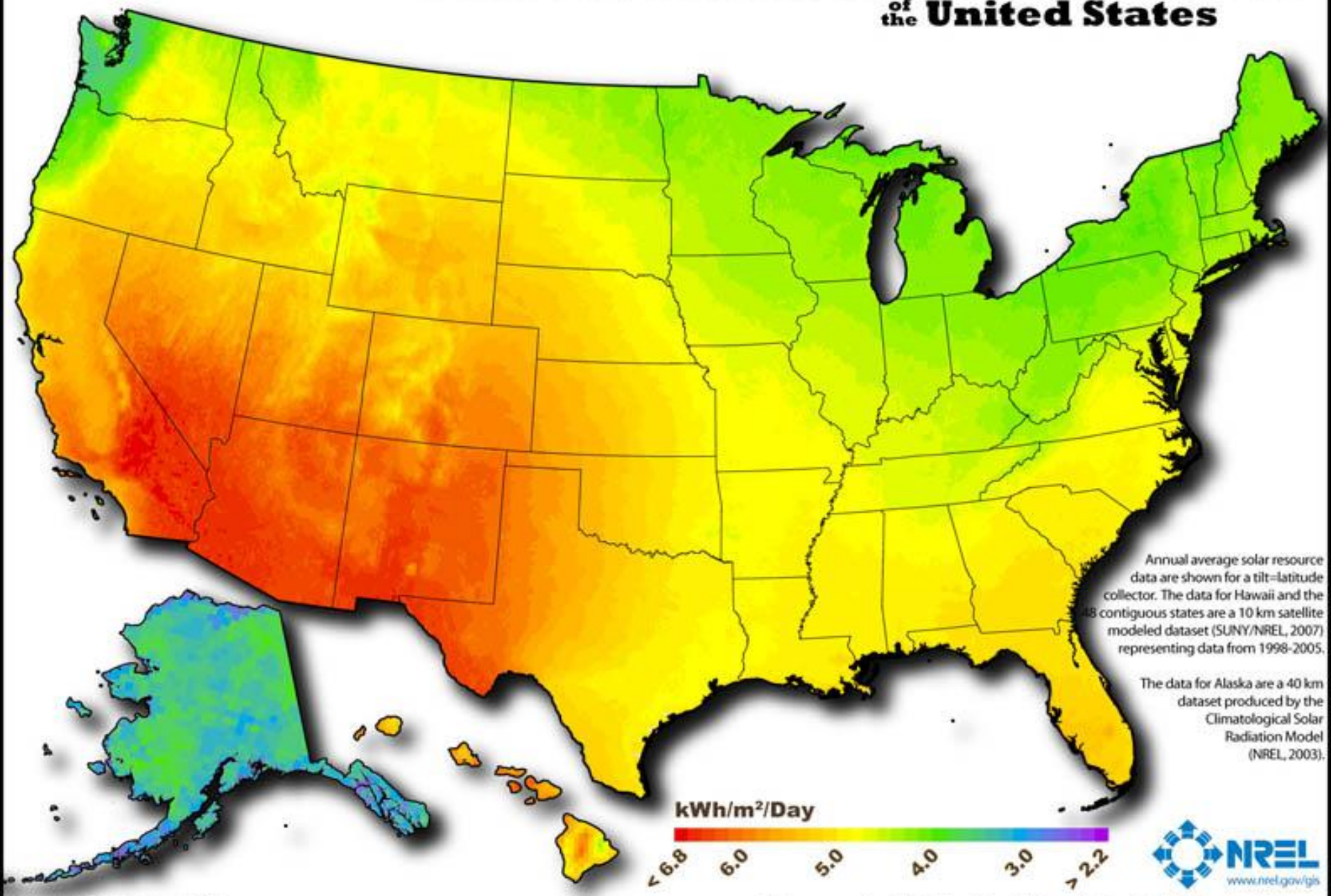


- Photovoltaic (Solar Panel) Resource Map

Source

http://www.nrel.gov/gis/images/map_pv_national_lo-res.jpg

Photovoltaic Solar Resource of the United States



Annual average solar resource data are shown for a tilt=latitude collector. The data for Hawaii and the 48 contiguous states are a 10 km satellite modeled dataset (SUNY/NREL, 2007) representing data from 1998-2005.

The data for Alaska are a 40 km dataset produced by the Climatological Solar Radiation Model (NREL, 2003).

NREL
www.nrel.gov/gis

Author : Billy Roberts - October 20, 2008

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.

How Do Solar Panels Work?

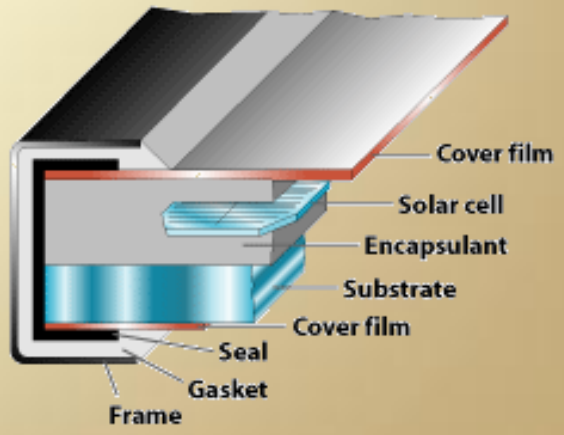
• Sunlight consists of little particles of solar energy called photons.

•Solar panels are made up of several individual solar cells which are made of at least 2 layers of semiconductor materials. One layer containing a positive charge and the other a negative charge.

• These materials are layers of silicon, phosphorus (which provides the negative charge), and boron (which provides the positive charge).

• As a PV cell is exposed to the sunlight, many of the photons are either reflected, pass right through or absorbed by the solar cell.

• When enough photons are absorbed by the negative layer,(phosphorus), electrons are freed from the negative semiconductor material.



How Do Solar Panels Work?

• These freed electrons naturally migrate to the positive layer (boron) creating an electric field at the surface where they meet, similar to a household battery.

• The electrical field causes the electrons to move toward the negative surface where they become available to the electrical circuit.

• When the two layers are connected to an external load, the electrons flow through the circuit creating electricity.

• A solar cell will typically produce between 1-2 watts of power each. In order to gain more power, these cells are connected together to make a solar panel (module) that will typically hold about 40 cells.

Source: http://www.solar-energy-scene.com/how-do-solar-panels-work.html

Setting-up A Solar Power System

- Solar Panel – Produces Renewable Electricity. 1 - 300+ Watts, Most are 12V, Avg. price $2.50-$3.00 per Watt.

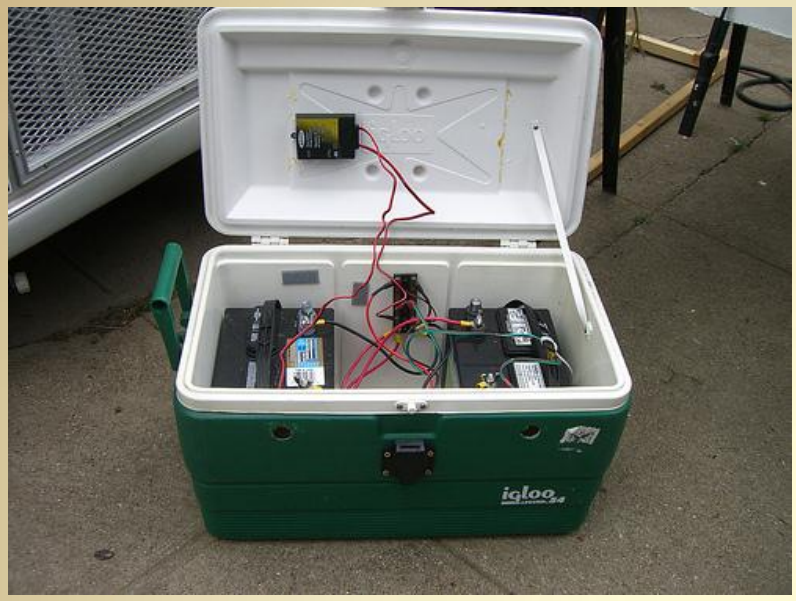
- Charge Controller – regulates the voltage and current coming from the solar panels, as sun exposure ↑or ↓,the output of the panels fluctuates. The controller prevents overcharging of the battery. Price $20 and up.

- Deep Cycle Battery – As the panels produce electricity, it travels through the circuit, if nothing is available to store it, the electricity is gone. Batteries store electricity until it is ready to be used. Deep-Cycle batteries can withstand prolonged, repeated and deep discharges which are typical in solar systems.

- Inverter - An inverter changes DC voltage to standard AC voltage. This way you can run your standard household devices. Converting voltage does create a loss of efficiency (10%-20%) so use 12V DC direct from your battery if you can. Price $30 -$3000

- Device – This is the appliance you need to power. An AC device can be plugged into the Inverter, 12V DC devices can be powered directly from the battery.

Portable Solar Power

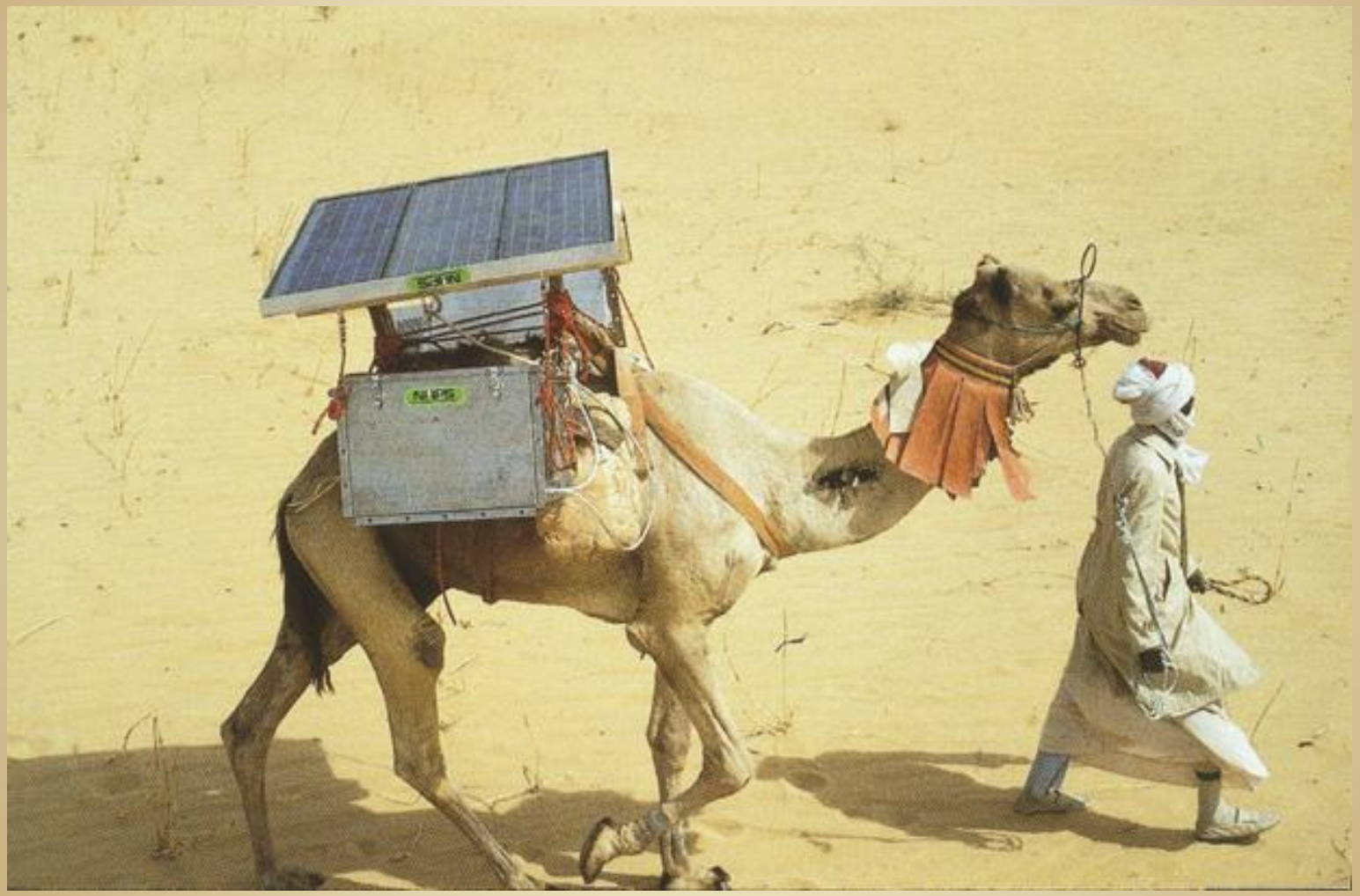


http://farm3.static.flickr.com/2183/2333527870_aff304261d.jpg

Portable Solar Power

http://www.acpowersupply.co.za/nonmobilesolar_img.html

Portable Solar Power



http://www.azdiscountsolar.com/images/powercamel.jpg

Human Power

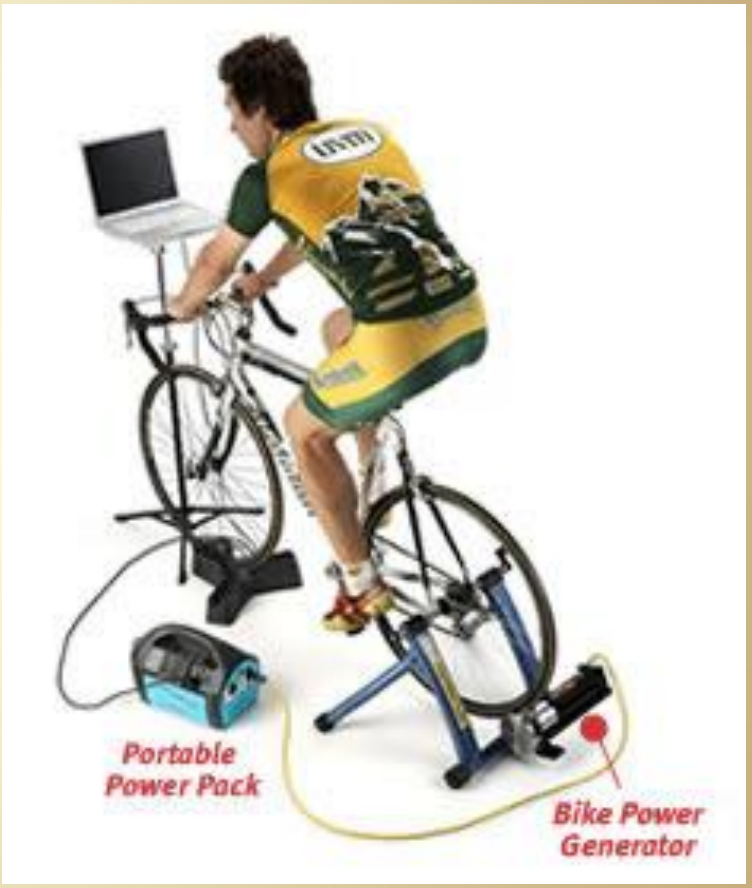
- Pedal powered backup generators - With the newly available white LED as a light source, a few minutes of pedaling would be enough to create hours of light.
- Assume an emergency keeps you indoors. it can give you something to do besides staring at the walls.
- It is totally safe with no fuel or fumes!
- Generators or solar panels could invite invaders in tough times.
- Pedal Power is the only power source you can use to produce power while indoors.

Human Power

- 30 minutes of pedaling produces about 100 watt-hours. That's about enough energy to power:
  - A clock radio for 10 hours
  - A 15-watt compact fluorescent light bulb for 6 hours, 40 minutes
  - A laptop computer for 2 hours
  - A 19-inch LCD TV for 1 hour, 40 minutes
  - A toaster for 7 1/2 minutes
  - An iron for 3 1/2 to 6 minutes

For Plans to build your own system check out: www.pedalpowergenerator.com

Human Power



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