
HOME POWER 11

Home Power

People

Sonia Cantrell
Sam Coleman
Windy Dankoff
Linda Gaydos
R.T. Gaydos
Chris Greacen
Brian Green
Steve Hicks
Kathleen Jarschke-Schultze
Art Krenzel
Sylvia Krenzel
Stan Krute
Steve McCarney
Karen Perez
Richard Perez
John Pryor
Linnea Rassman
Fred Rassman
Lawrence Schechter
Daniel Statnekov

Cover Photo Master by
Richards Advertising, Ft. Jones, CA

Issue Printing by
Valley Web, Medford, OR

Legal

Home Power Magazine is a division of Electron Connection Ltd. While we strive for clarity and accuracy, we assume no responsibility or liability for the usage of this information.

Contents

Access

Home Power Magazine
POB 130
Hornbrook, CA 96044-0130

916–475–3179

Think About It

"Minds are like parachutes. They only function when they are open."

Sir James Dewar

Cover

Up close and personal with a polycrystalline photovoltaic cell.

Photo by Brian Green & Sonia Cantrell

Welcome to Home Power #11

The mountains are warming up under the gentle spring sun. It snowed day before yesterday… Everyone is busy putting PV modules out in the sun, where they belong. I must say it has been hard, staying glued to the keyboards, while spring is happening all around us. There's so much to do.

One of the things that is done is HP #11. This issue is eight pages larger than any other. It also goes out to more readers than ever (almost 12,000 under 3rd class labels). We're happy to see HP growing and want to thank everyone who helps. Thanks, First Class HP types, contributors, advertisers, and the HP Crew for making this the best one yet.

A word on "Things that Work!" From the questions we get, I guess our equipment test and report attitude must seem strange to some people. We don't do negative reviews. If a product meets our Things that Work! criteria, then we write it up. If it doesn't, then we don't. Things that Work! test reports are not solicited, paid for, or contingent on advertising, by the equipment's manufacturer. They are as objective as we can make them. All products are tested in working systems. The criteria for Things that Work! are simple: 1) the device must do what its maker says it will, 2) the must survive in an actual working system, and 3) the device must offer good value for its cost.

Enjoy HP #11, we sure had fun doing it.
the HP Crew

Mowing Fields Is In My Past

Daniel K. Statnekov

Woke up this morning in distress
Couldn't figure it out but none-the-less
My face and nose was all filled up
A sneezin fit did bad erupt

Minds me of a time gone by
When I tried farmin' for awhile
And sat up on a tractor high
To mow a field and grow some rye

Mostly brush and untamed weeds
In pasture home had gone to seed
Planned to plant alfalfa tall
An' feed it to the stock in Fall

Thoughts of all that bright green hay
Filled my head throughout the day
And as I cut that pasture down
Didn't see nothin' 'cept the ground

The dust that rose was thick to breathe
Choked me some and made me heave
But worse there was a yet to come
And what it was no more fun

A cloud of pollen in the air
Surrounded me and filled my hair
To plague and overcome my day
And banish thoughts of all that hay

Crept into every clothing crease
To find my skin like some strange beast
The itch it caused is more 'n words
And big red welts came out like herds

Started me sneezen 'n' scratchin hard
Equilibrium completely jarred
Until my eyes were red with tears
And mind was clouded o're with fears

That some disease unknown to me
Would soon fulfill its destiny
And sure I'd be beneath the ground
To nare again hear any sound
I shut that tractor down so quick
You would of thought a country hick
Had run against a hive of bees
The way I lit out for the trees

A pullin' clothes off as I went
And hollerin' loud to God give vent
Scratchin' itchin' over all
Forgot about that coming Fall

And all the hay I planned to make
Or how I'd turn it into steak
Instead through reddened eyes of pain
Looked toward the river for my gain

Near naked now I made my way
Like some demented soul to pray
And ducked my head beneath the stream
To wash away that field's bad dream

My sneezin' stopped and itch did too
You'd think that boy had earned his due
But not at all, my steps turned back
To where I'd left that tractor slack

And started once again my chore
Thought what had happened here-to-fore
Until that cloud of dust arose
To once again on me impose

Its dreadful scratch and choking fit
That told me sure that this was it
Within me lived some adverse form
To cuttin' weeds that wasn't norm

And so retraced my steps in haste
To plunge my itch and wash my face
And then I knew the truth at last
That mowin' hay was in my past.

Mini Hybrid Power System

R.T. Gaydos and Linda L. Gaydos

Eight years ago we purchased remote acreage in the Sierra Foothills of Northern California and wished to build a small energy efficient cabin on it. After discussion with the local power company we were told that it would cost $10,000.00 to extend electrical service. Our cabin site is 1,800 feet from the closest power pole, and they charge about $5.60 a foot. Also, the power company could not even give us a possible date as to when we could expect electrical hookup. The only affordable solution was to make our own electricity by alternative means. We were fortunate to live in an area where there were two renewable energy stores, so ideas and advice were readily accessible.

Hydroelectric

In our area the annual rainfall is 55 inches and runoff from Sierra Mountain snow melt creates an abundance of natural spring water. Our springs are well above our cabin site, so we've got gravity flow water. This coupled with the fact that a small inexpensive 12 Volt hydroelectric generator was being made locally made the decision to go hydro easy.

The main component in our system is the HydroCharger I™, designed and built by Sam Vanderhoof of Independent Power Co. in North San Juan, CA. This is the smallest hydro unit I know of. It weighs approximately 20 pounds and is 12" x 8" in size. The hydro unit has a 4" diameter pelton wheel rotating on the horizontal axis, connected to a small permanent magnet generator. According to the manufacturer, it will generate up to 2 Amperes of current and begins producing electricity with water flows of 12 gallons/minute at 3 feet of fall.

We have about 40 foot fall with 500 feet of run, going from water source (springs) to cabin where the generator is located. The two springs we have tapped give us a total of 6 to 12 gallons/minute of flow depending on the time of year. This gives us from 1 to 1.5 Amperes from the Hydro. The hydro runs constantly, therefore we get 24-36 Ampere-hours per day.

In our system water is collected in a catch basin under each spring, from where it runs into a 35 gallon plastic reservoir and through 1.25" PVC pipe downhill 500 feet to the cabin. Larger pipe, at least 1.5", should have been used to reduce interior line resistance.

The hydro unit is located under the floor of the cabin with a valve running up through the floor of the bathroom, allowing the hydro to be turned on and off inside. This is helpful because our gravity flow water system that feeds the hydro unit is also our domestic water supply. When we are getting low flows of water, like late summer & fall, we can turn off the hydro unit to obtain more water pressure for showers.

Occasionally cleaning the debris from the catch basins' screens is the only maintenance needed for the water collection system. The only maintenance adjustment we need to make on the hydro unit is to change the water nozzle size, depending on available water, ie. too big of a nozzle without enough water will cause air to be sucked into the water line (penstock). Nozzle orifice sizes we use are 1/4" to 1/2" in diameter.

We originally had trouble with the HydroCharger I™ and replaced the lower bearings in the generator unit several times. Acidic water

Left: the MicroHydro lurking under the porch of the house. Photo by Brian Green

Center: the Gaydos' home. Note PVs on the roof. Photo byR.T. Gaydos

Right: Roger & Linda having fun.

was getting inside the generator and causing severe corrosion. This problem was solved by the manufacturer, by elevating the generator from the housing with 3/4" stand offs and putting a splash guard collar on the generator shaft. This modification is now standard. Since last bearing replacement and modification, the HydroCharger I™ has run continuously for 4 years without any trouble. It is a **very** reliable component.

Photovoltaic

Another part of our mini hybrid power system is a single Solex 35 Watt PV panel, it produces 6 to 10 Ampere-hours per day. The panel is located on the roof of the cabin and is accessible by a roof ladder for cleaning, snow removal and redirecting toward the sun. Although roof mounting is not best, it was the only place close to the cabin that would give optimum solar exposure. The PV panel was also purchased to qualify the system for the now defunct State & Federal Solar Energy Tax Credit.

Back up Power

The third producer of this hybrid system is a used 2,800 Watt Yamaha gasoline engine/generator. It is used in conjunction with a Sears 50 Amp heavy duty battery charger to charge the 12 Volt battery bank when it gets too low. It is needed infrequently to charge batteries, but is necessary to run a 10" radial arm saw and Maytag clothes washer.

Energy Storage - Battery Bank

The 12 Volt power produced by hydro, solar panel or generator/charger is transferred and stored in a bank of deep cycle, lead-acid golf cart batteries. There are six, 6 Volt, 220 Ampere-hour batteries wired in parallel and series to yield a 660 Ampere-hour, 12 Volt storage bank. Batteries are located inside the cabin in a window seat/battery box. The box is sealed to the interior of the cabin and vented through the wall to the outside. The vent dissipates the hydrogen gas created by the batteries.

We have used the same collection of batteries for four years. Unfortunately, all six batteries were not purchased at the same time, i.e., the first set was used, the second set was purchased 9 months before the third set. This was definitely an error because batteries develop a charging memory and will only accept a charge as high as the oldest or worst battery. None the less, they are forgiving because the batteries are continuously being charged by the hydro unit. If we were depending primarily on solar panels, we doubt that the batteries would be so forgiving. See HP9, page 27, for more info on lead-acid batteries.

Distribution and Consumption of Power

From the battery bank, 12 Volt power goes through a DC circuit breaker panel and to its various points of consumption. We have eight separate 12 Volt circuits. 12 Volt battery power also supplies the Trace 1512 inverter. The inverter's ac power then goes through an ac circuit breaker panel and on to various points of ac consumption. There are four separate ac circuits, with one going up to the woodworking shop which is 100 feet away from the inverter.

Appliances run by 120 vac inverted power are a small microwave, phonograph turntable, word processor, toaster, blender, mini drip coffee maker, vacuum cleaner, hair dryer, hair rollers, small clothes iron, 8" table saw, 7 1/2" skill saw, drills, sanders, 10" miter saw, etc. The only thing the inverter will not run is a Sears 10" radial arm saw and an automatic clothes washer. These must be run by the ac gas generator. All ac appliances were purchased with energy efficiency and low power consumption in mind.

The main consumer of power in our system is 12 Volt lighting. We have 14 separate lights, which are either incandescent, fluorescent, or quartz. Fluorescents seem to be the most efficient (illumination/amps) with quartz a very close second and incandescents a distant third. We have strategically placed lights and semi-gloss white walls to help reflect light. Location is the most important factor in efficient lighting. Lighting uses approximately 1/2 of the power we make. Our other 12 Volt appliances, 12" B/W TV, Hi Fi, CD player and fans use another 1/4 of the power generated. The remaining 1/4 of the 12 Volt power is inverted to 120 volts ac and is consumed by ac appliances.

We have on the average 36 Ampere-hours at 12 VDC per day of power available, depending on hydro and solar panel output. Disregarding about the power losses due to power inversion and charging, the following chart was devised.

Power is monitored via a metering panel which tells voltage of battery bank & amperage being consumed. Amps and Volts output of hydro and solar panel are also displayed. The metering panel was built with analog meters and is flush mounted in the wall above the circuit breaker cabinet. It is helpful to see what's happening via gauges, especially with the hydro charger, because its current output can easily be translated into water output (gals/min).

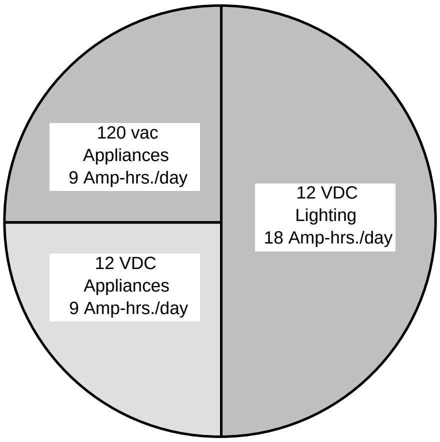
There is no controller because amps produced are small enough that the battery bank can not be over charged.

System Cost

HydroCharger I™ - $500.00

35 Watt Solex panel - $300.00

2,800 Watt Yamaha gas generator (used) - $400.00



(6) 6 Volt DC batteries (2 used) - $300.00

Trace 1512 inverter - $1,100.00

500' of 1 1/4" PVC pipe - $200.00

Monitoring panel, circuit breakers, wiring, outlets, how to books & publications, fans, light fixtures and miscellaneous = $1500.00

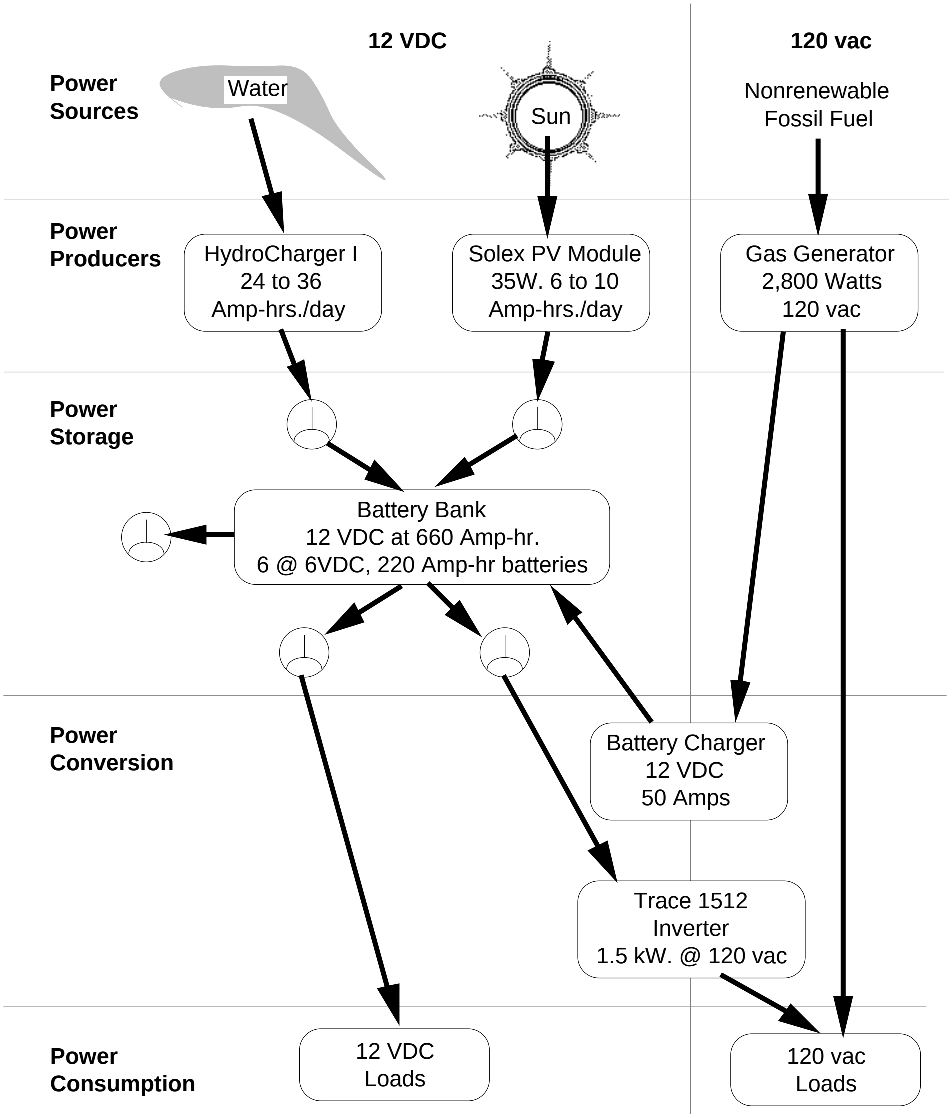
Total Equipment Cost = $4,300.00

The actual cost was greatly reduced due to the State and Federal Solar Energy Tax Credit which saved us approximately 40%. This incentive to save energy and use renewable energy sources has sadly expired. The cabin, which is 600 sq. ft. was designed and built with this power system as an integral part. It took us about 400 hours to design and install all electrical components of the system. I would venture that a professional could have done it in half the time.

Ideas and Ramblings

Our energy needs are also met by using propane for refrigeration, cooking and hot water. We have an Aqua Vac on-demand hot water heater, supplemented by a small water heater in the woodstove. We use approximately 200 gallons of propane a year. Our Thelin Thompson T-1000 woodstove is thermostatically controlled by a 12 Volt freon damper switch and is the winter space heating source for the cabin.

The U.S. average power usage is approximately 10,000 Watt-hours per day. By being conservative and designing a small home's



"How To Be Your Own Power Company", by Jim Cullen. This guide to low voltage technology and alternative power design was invaluable in developing our system.

"Basic Home Wiring Illustrated" by Lane. Introduction to basic electric terms, system design and construction. For the do-it-yourselfers from Sunset Books.

Electrical Independence Booklet Series by David Cooperfield. Well-Being Productions, POB 757, Rough & Ready, CA 95975. This series of booklets on electrical independence is most helpful.

lighting and electrical needs efficiently, we manage to be comfortable on approximately 700 Watt-hours a day.

In the future we plan to install another HydroCharger I™ downhill from our cabin and recycle expelled water from the first hydro unit to operate a second unit. It will have 40 feet of fall and be 140 feet away. It is estimated that power generation will increase 50% to 60%, this will enable us to run an efficient automatic clothes washer and color TV.

Endorsements

Sam Vanderhoof and Ron Kenedi, Photocomm, Inc., Independent Power Division, 930 Idaho Maryland Rd., Grass Valley, CA 95949. They manufacture the HydroCharger I™. We received valuable advice, great components and excellent service after the sale from Sam & Ron. Thanks!

Jon Hill, Integral Energy Systems, 105 Argall Way, Nevada City, CA 95959. Jon has helped us numerous times with products and advice. His workshops on alternative energy and hot water production are great!

Trace Engineering, 5917 195th NE, Arlington, WA 98223. We own the Trace Model 1512 Inverter. Everybody knows the Trace is the greatest.

A Wind/PV System

Fred & Linnea Rassman with son Dylan

In 1971 I bought 10 acres in central Allegany County, New York and started building an A-frame house. I used all hand tools since there was no electricity available. After I completed the house, I checked on getting the power line installed and found out the power company wanted $10,000 to bring in the lines. Then they wanted a monthly rate even if I didn't use any power, since I was the only one who would be using that line. Well, that was out of my price range, so I gave up on commercial electricity. I used kerosene lamps for light, an old Servel gas refrigerator, a hand powered pump for water, and a portable radio and cassette tape player that I ran off my truck battery.

Enter Wind Powered Generators

I started playing with homemade wind powered generators around 1975. I found the most I could get from car alternators was around 300 watts. Even when I rewound them to run direct off an 8 foot diameter blade they just didn't supply enough to keep the battery charged.

So, I started writing around the country. Mike Hackleman told me that Martin Jopp out in Princetown, New Mexico might have a Jacobs windmachine he would sell. It turned out he had a 1949 Jacobs 2,800 watt, 32 Volt DC wind generator that was still in the packing crate, brand new and never used! He wanted $2,500 for it, which was still a lot of money for me back in 1977.

I managed to get a loan and drove to Princetown, New Mexico to meet him. What a character! He was in his seventies and still running his farm on wind power, as he had since 1920. He used two Jacobs, each putting out 60 Volts to charge a 120 Volt battery bank. He taught me a lot of DC stuff, including how to rewire 120 volt appliances and tools to run on 32 Volts.

I packed up my Jacobs, five or six 32 Volt motors and drove back to western New York. Then I tried to find a used tower. All I could locate was old water pumping towers that were 20 or 30 feet high. They wouldn't support the 15 foot diameter blades of the 600 pound Jacobs. So I bought a bunch of used 2 inch pipe and sucker rod from the oil fields and welded up my own 50 foot tower. The pipe and welding rod came to $50.00. I bought a keg of beer, some food, and invited some friends to a tower raising party. We used two tractors to stand the tower up while we cemented it to the ground. I used a tree surgeons bucket crane to put ole Jacobs atop the tower and in July 1977 had a system operating.

The Jacobs didn't seem to be putting out enough juice so I wrote to Marcellus Jacobs in Florida and asked him what was wrong. He wrote me a nice long letter explaining that the brushes had to be timed. The only way to properly do this was when it was blowing at top speed. It was pretty hairy, with me hanging on to the back of

12 ARCO PV panels on a Zomeworks Passive TrackRack.
Photo by Fred Rassman.

The Rassman home and ole' Jacobs.
Photo by Fred Rassman.

ole Jacobs with the blades whipping so fast I couldn't see them. Anyway, it didn't kill me and I finally got the sparking down to a minimum. When I told Marcellus that my Jacobs was unused in the packing crate he wanted to buy it back from me. He offered me a deal on his new 10kW. alternator model. I said no thanks, but we kept in touch until his death.

Lead- Acid Batteries

I started out with five 6 Volt golf cart batteries and soon found out what deep cycle service really is! First of all, when Jacobs was putting out its full power of 70 Amperes at 40 Volts it was too much for the 180 Ampere-hour batteries. Then when the wind didn't blow the batteries would be discharged for a week. So I built a gas engine/car alternator battery charger for windless periods. But even so, in a little over a year a couple of the battery cells were badly sulfated and useless. I had actually been undercharging them when I thought I was bringing them up to full charge. I found out you have to ruin a set of batteries before you learn how to charge them! See Home Power #9 for details on battery recharging and sizing.

In 1979, I finally found some used telephone batteries out in Indiana. I bought 64 C&D, 500 Ampere-hour cells and a diesel engine starting set of Goulds 310 Ampere-hour cells that were put in use in 1958! I'm still using the Goulds as my primary set. In 1982, I ran into 66 more C&D 300 Ampere-hour telephone cells that I got for hauling them away. With 130 C&D cells I had to build a shed with a strong floor to hold over six tons of batteries. I split them into 8 separate sets of 16 cells and connected them with knife switches. I can use them either for powering the house or barn and charge each set separately.

When the wind blows for a couple of days I still had too much power to store in batteries. So I bought three 32 Volt, 1,000 watt immersion water heaters and built a relay setup that would switch the windmill power to the water heaters when the voltage reached 41 Volts and kick off at 36 Volts, so the heaters wouldn't draw directly off the batteries. It sure is nice to take a hot shower or wash dishes with free Hot H_2O. I super insulated the tanks so when I get the temperature up to 190°F. it stays warm for 4 or 5 days.

Fred Rassman's Battery House.
Photo by Fred Rassman.

Along the way I rewired my 1/2" drill, 1/4" drill and an old vacuum cleaner to run direct off 32VDC. I also built a couple of voltage regulators to run anything from 0-32 Volts, like a 12V color TV, 12V cassette player & radio, 9V record turntable I built from an old Garrad and numerous cordless items that range from 1 1/2 Volts to 16 Volts.

Inverters

I bought a Best 3,000 watt inverter from Elliott Bayley out at Whirlwind Power Co. in 1980. I still use it for big power tools. It's a nice inverter, but it was always on draining power with no load. Besides the efficiency when operating is around 80%. Two years ago I bought a Trace 32 Volt 2,100 watt inverter from Bob McBroom at Kansas Wind Power and it's ten times the inverter that the Best was! I really love it. I still try to use most appliances directly off of 32 Volts and use the inverter sparingly.

I'm not in the best wind site, so for June, July, and August I still had to run a gas engine charger. I built a big one using an ambulance alternator coupled to a 2 cylinder 16 horsepower Wisconsin Bailer engine by a sprocket and chain drive. I tried V-belts, but kept burning them up, no matter how tight they were. I left the alternator diodes original and hooked up a variable field voltage control. It puts out 120 Amperes @ 45VDC continuously.

I got married to a wonderful woman, Linnea, in 1985 and started a family. I soon found out that the energy requirements increase with a wife and kids! I was forced to run the gas engine charger 5 hours a week during the summer months and that was too much.

Photovoltaics

In the summer of 1986 I got into photovoltaics. I had always wanted them, but couldn't afford them before. I wound up with a system of 12 ARCO M65 panels and a Zomeworks 12 panel passive tracker that I bought from Bob at Kansas Windpower. I bought the smallest (32 series cells) panels because I had to wire 3 panels in series to charge 32 Volts. See HP3, page 10, for more information about different voltage PV panels. I figured I didn't need the larger panels designed for 36 Volts and wind up wasting extra voltage. Even so, the first time I put them on line I got more than their rated power.

On paper the PVs were supposed to produce 11.6 Amperes. I was getting 15 Amperes on cold days and 12 or 13 Amperes on warm days. The amperage stayed constant even as the batteries climbed up to 41 Volts. It's not often you get more than manufacturer's ratings. Plus with 90 solar cells to charge 32 Volts, I get 3 or 4 Amperes on overcast rainy days from 12 solar panels. It figures out to that when the solar cell voltage reaches .355 Volts they start charging. It's really astounding to walk into the battery shed on a sunny day and hear 6 tons of batteries gassing at 41 Volts from a meager 12 Amperes. It sounds like it's raining.

System Specs

All 8 sets of batteries plus the Goulds, are wired up so I can charge one set off the solar panels, another set off of the Jacobs and run the house and barn off a third set, or any combination of two or more sets connected together. Since I started using the ARCOs in the summer of 86, I haven't had to start the gas engine charger once. Mostly, the ole' Jacobs is used directly for heating water.

Photovoltaic power is simply amazing. I'd recommend it to everyone interested in alternative power. Wind generators are great IF you have plenty of wind the whole year and IF don't mind climbing a tower once a year or more to perform maintenance or repairs. It seems that the only time they break down is when it's 0° and blowing 40 MPH. The only wind generator I'd recommend is the Jacobs, most of the ones today are overpriced and won't stand up for more than 5 years.

I spent two years in the early 80's traveling around the country installing towers and wind generators. I've seen the new models trying to work and know what I'm talking about. They don't produce

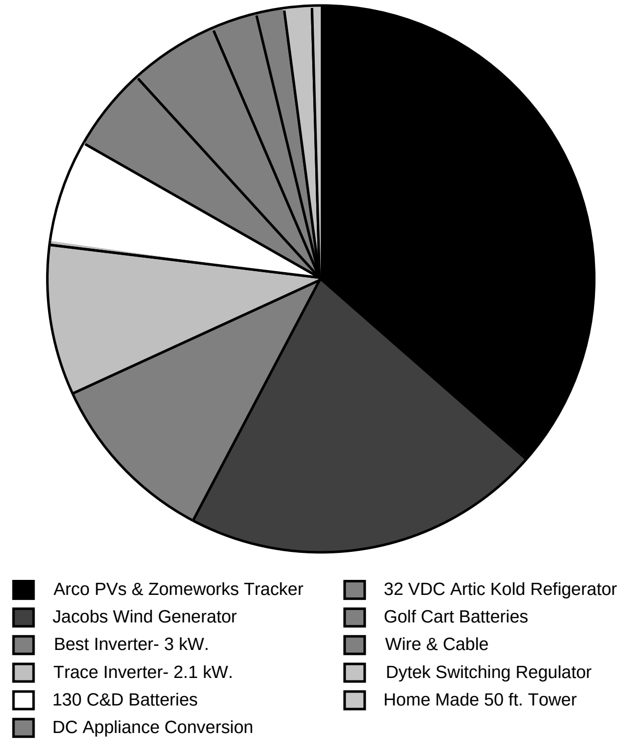
Fred, Linnea, and Dylan Rassman.
Photo by Fred Rassman.

rated wattage until a wind speed of 25 or 30 MPH which is rare. The ole Jacobs reaches rated power at 18mph. Most of the new models shut down completely after a certain wind speed, so you get no power when it's blowing 35 or 40 MPH, while the Jacobs still continues producing full power up to 60 MPH.

As for system cost and monthly usage in watts I'll have to give general figures because over 15 years I've purchased various motors, relays, switches and appliances that I don't use any more. I've got a brand new Rohn SSV-80 foot tower that is still in the packing crates, never used. I paid over $4000.00 for it and I won't be using it now. I'd like to sell it and buy another 12 panel PV system. Anyone out there interested in an 80 foot tower? I'd sell it for $1,000.00 less than the current price. Anyway, here goes a cost breakdown:

As for power usage I'd guess around 150 to 200 kWh/month depending on the season. The solar panels produce an average of 60 kWh/month. And ole Jacobs produces an average of 200 kWh/month. For a total of 3,120 kWh/year with the extra power going to heat water.
Fred Rassman, RD.1, Belmont, NY 14813.

Equipment Item	Cost	%
Arco PVs & Zomeworks Tracker	$4,300	36.6%
Jacobs Wind Generator	$2,500	21.3%
Best Inverter- 3 kW.	$1,200	10.2%
Trace Inverter- 2.1 kW.	$1,100	9.4%
130 C&D Batteries	$700	6.0%
DC Appliance Conversion	$600	5.1%
32 VDC Artic Kold Refigerator	$600	5.1%
Golf Cart Batteries	$300	2.6%
Wire & Cable	$200	1.7%
Dytek Switching Regulator	$200	1.7%
Home Made 50 ft. Tower	$50	0.4%
TOTAL	$11,750	



Electrical usage according to voltage is:

12 VDC
- 9" color TV
- 12" Black & white TV
- radio & cassette player
- curling iron
- cordless vacuum
- cordless toothbrush
- cordless Makita power tools
- TV signal amplifier
- muffin fans
- ceiling fan
- small air compressor
- small water pump
- soldering iron
- stained glass grinder
- blender
- Sunbeam mixer
- 8 1/2" Rockwell circular saw
- belt sander
- food processor
- 14" electric chainsaw
- small washing machine
- 5 gallon shop vacuum
- travel iron
- movie projector

32VDC
- all lights
- water pump
- 200 Amp Arc welder
- table saw
- band saw
- 1/2" and 1/4" drills
- hot water heaters
- 8 cubic foot refrigerator
- ringer washing machine
- Mullbank composting toilet
- small vacuum cleaner

115vac
- VCR
- sewing machine

Wincharger and Jacobs

Steve Hicks

Wincharger and Jacobs wind generators were the two most common types during the pre REA (Rural Electric Administration) days of the 1930's, 40's and early 50's. Although this might seem like an article about antiques, it is a short description of the most cost effective wind machines in the 150 to 3,000 Watt range available today. These machines worked fine for thousands of rural people a generation or two ago. They can sometimes be put back into service for under $300 and many hours of work. IF you are living without utility power, have a windy site, better than average do-it-yourself skills, and willing to put in some hard work, then a wind generator installation is more cost effective than PVs.

The most common Jacobs wind plants are 1,800 and 2,500 Watt, 32 Volt direct drive machines with 13 foot diameter three blade props. The 300 to 375 pound generator only turns about 225 rpm at top speed. This means very long generator brush and bearing life. Winchargers came in a much greater variety. Some early models had a small 20 pound, direct drive, 6 Volt generator driven by a high speed (900 rpm) six foot diameter prop. These small 6 Volt units were often sold with a Zenith radio when the Wincharger Corp. was owned by Zenith. A popular 32 Volt Wincharger in the 1,000 Watt range had a 10 foot diameter two blade prop driving a 50 pound 32 Volt generator through a gearbox. The largest Winchargers had a 12 or 13 foot diameter four blade prop, turning a 1,500 Watt 85 pound generator through a gearbox. Up until the last three years, 12 Volt Winchargers were still being made in 200 and 450 Watt models. Newer design 10 kiloWatt and larger Jacobs that tie into the utility lines are still being built.

Since the end of the tax credits in 1985, the demand for wind generators has fallen off and so have the prices. It is still possible to find unrestored one owner wind generators. Many times these can be had for under $200. Although the price is low, there is generally a lot of time spent in the search. In all likelihood, the wind generator won't be complete. A lot of individuals have given up on their rebuilding effort as soon as they price a new set of blades. In the case of the Jacobs or a large Wincharger the new blades may run two or three times the original purchase of the used machine. The airbrake governors for the Winchargers is another item that is in short supply, many just didn't survive.

If you have priced a rebuilt machine from a dealer, it may seem expensive, but it really isn't when you figure all the time that went into restoration. I know of no wind generator dealers that are getting rich, most are not even making money above the poverty level. Instead of money there is a lot of job satisfaction working with other energy independent people.

Since Energx Corp. stopped production of their 200 & 450 Watt Winchargers, I know of no good buys in small units. Although there may be a few good machines being currently made, the ones I'm aware of are expensive for the amount of power produced. This is not saying current manufacturers are rip-off-artists. There just isn't enough sales volume to mass produce the units at a lower cost.

An early homebuilt wind generator using a Chevy Vega rear end, a 50 Ampere, 12 VDC truck generator, and a 9 foot diameter prop with a variable pitch governor. Photo by Steve Hicks.

With a good wind site, you could generate hundreds of kiloWatt-hours a month. That's enough to use all the appliances you already have without buying expensive specialized DC ones. For many people, a wind generator makes sense, complimenting a PV array. Most areas of the country are windiest during the winter months when the sunshine is least. Restored Jacobs and Winchargers are proven reliable and will remain popular until the demand for new wind generators decreases their price.

Steve Hicks started building wind generators in 1980 and now specializes in rebuilding old Winchargers. He will answer short specific questions from Wincharger owners free of charge if an SASE is enclosed. The address is Mountain Pass Wind, 711 North C, Livingston, MT 59047. RP

Support Home Power Advertisers!
Their advertising makes Home Power FREE!

Solar Powered Water Pumping

Windy Dankoff and Steve McCarney

A quiet revolution is taking place in the way water is pumped beyond the electric power lines. Solar power provides a welcome alternative to fuel-burning generators, cumbersome windmills and tedious handpumps. Over 20,000 solar pumps are in use throughout the world. Most of them are small systems for remote homes, livestock and village drinking water.

Solar pumps are gaining in popularity because they are reliable, require no fuel, are easy to install, and require little maintenance. They are now economical at locations not served by electrical utilities. Solar pumps move the most water during dry, sunny weather when the most water is needed. These and other advantages add up to satisfied users willing to tell their story.

"Never had a minute's worth of trouble" says Arizona farmer Gary Scott of his solar pump. Echoing Scott's report is Gary Richards, electrician at the Philmont Boy Scout Ranch in New Mexico, where 13 solar pumps are operational and another 7 are planned. "We were looking at a $5,000 repair bill for our generator-driven pump and a new solar pump was selected because it was the same cost" says Richards. Philmont administrators already knew about the high reliability and low maintenance of solar power.

Solar Technology

At the heart of the technology is solar electricity, also known as PHOTOVOLTAICS or simply "PV". Photovoltaics directly convert light (not heat) into electricity. The generator in a solar electric system is the PV MODULE. When sunlight strikes a PV module direct current (DC) electricity is produced. A typical PV module in full sunlight will produce over 3 Amperes of current at 16 Volts (50 Watts). Modules are easily assembled into a larger array that produces the desired voltage and current. While the current varies with the intensity of sunlight, usable power may be derived from a properly designed system even during moderately cloudy weather.

The most common uses of PV power are for small electrical requirements in remote areas. PV systems are already in use for a variety of applications including offshore navigational aids, mountain top radio repeaters, environmental monitoring, billboard and sign lighting and homes. Most of these systems use batteries to store electrical power for nights and cloudy periods. PV pumping systems are often simpler, using water tanks for storage instead of batteries.

Pumping with PV Power

PV powered well pumping differs fundamentally from conventional pumping methods, particularly where water requirements are modest. To work reliably, solar pumps must work well at reduced speeds during low-light conditions. On sunny days the system must pump more than the daily requirement in order to refill the system's water tank. Five to ten days storage may be required, depending on climate, pattern of water usage, and whether there is a back-up source of water or energy.

Most well pumps are too fast and powerful for direct solar power. It is a fact of physics that the larger a pump is, the more efficient it tends to be in terms of energy ($) per gallon pumped. Utility or engine power is usually used to pump at a high rate over short periods of time, thus gaining efficiency as well as minimizing running time, wear and noise. Solar pumping is opposite in nature. It is most economically applied at low power levels over the course of the day using pumps designed for the purpose.

Where water requirements are less than 3,000 gallons per day, a solar pump should be low in flow rate (5 GPM or less) without sacrificing efficiency. Many homes require only 100 gallons per day for luxury living. At such low flow rates ordinary well pumps are not energy-efficient. Conventional pumps (including the popular submersibles) use CENTRIFUGAL FORCE to push water. They don't work efficiently below 5 GPM, and their performance drops off disproportionately at reduced speeds (under low light conditions). Also, conventional pumps use ac motors that don't work at reduced voltage.

One solution to these problems involves the use of storage batteries and a conventional ac pump. Energy accumulates over time in the batteries and is discharged quickly to run the pump for short periods. A battery system complicates the installation, operation and maintenance of a system (unless it is needed for other home applications) and loses 20% of the stored energy. Operation of ac pumps with DC power requires an inverter. The inverter adds cost and complexity and increases energy requirements by an additional 10%.

The most efficient low volume, non-battery systems use a POSITIVE DISPLACEMENT DC PUMP. Positive displacement pumps seal water into cavities and "squeeze" it upward, rather than "blowing" it up the way centrifugal type pumps do. These pumps work efficiently even at crawling speeds. DC motors also work well at varying voltages and speeds. Overall efficiency of today's DC solar pumps may exceed 3 times that of a conventional pump with battery storage and inverter.

A number of companies make specialized DC pumps for deep wells. Choices include diaphragm, rotary vane piston and jack pumps (all positive displacement types). They are available in a wide range of sizes from 1HP down to an incredible 1/10HP. The low power pumps offer cost savings due to smaller PV arrays, reduced pipe and wire size. And they can still lift 200 feet or more! Low pumping rates allow the development of low yield wells and springs. Specialized PV/pumps make it economical to develop a marginal water source a long distance from the point of use. Long wire runs are eliminated by site produced electricity and pipe size is minimized by low rate pumping.

The smallest "Micro-Submersible" solar pump system (priced under $2,000, complete and delivered) can pump 1/2GPM from 200 feet. That's 100 to 300 gallons per day with a solar power system. With a 1,000 gallon storage tank, that's plenty of water for a small family. It's inconspicuous solar array measures only 10 square feet. The pump weighs only 14 lbs. and may be installed and pulled by hand.

Systems requiring over 1/2HP to pump over 3,000 gallons per day (roughly speaking) may use more conventional pumps (centrifugal, submersible or turbine) fitted with special DC motors. The shallower the well, the more likely this type of pump may be used. To determine the best pump for your requirements, determine your lift and volume requirements and compare specifications of the various types available -- OR, contact a PV or solar pump dealer.

System Configuration

Solar pump systems can be set up in a variety of ways to match your water needs and your water source. Technology allows a choice of either ac to DC power, purely solar or solar integrated with other sources of power.

Array-Direct Non/Battery

The simplest solar pumping systems use a DC pump wired directly to the PV array (a group of modules). This works with centrifugal DC pumps because DC motors start easily when lightly loaded. Positive displacement pumps however require higher starting torque (current) and are usually coupled to the PV array through a special controller.

Solar pump controllers deliver high current even in low light conditions by increasing the current at the expense of lower voltage (the electronic equivalent of low gear). This "automatic transmission" allows pump operation throughout the solar day, however slowly, even in moderately cloudy conditions. These controllers are known as "maximum power point trackers" or "linear current boosters". A system designed for reliable output in cloudy climates may have an oversized array to assure a more constant water supply.

Battery Systems for Domestic Water

Battery storage and ac/inverter pumping systems sometimes are appropriate. As more and more remote homeowners use PVs for their electrical needs, we find battery storage and inverters already in place or planned for. The conventional ac submersible powered by inverter is a viable option for domestic water requirements. The storage battery system allows pressure pumping on demand, day or night. A water conserving home using low-water toilets (1 to 1 1/2 gallons per flush) may use well under 50 gallons per person per day. Where water usage is minimal, efficiency is less crucial. As a rule, if the right DC pump is available and economical for the job, use it. If not, consider using inverter/ac power.

Sunnyside Solar is a PV supplier in West Brattleboro, Vermont. Their main market is remote home owners. Regarding solar pumping, owner Richard Gottleib reports, "What people want here is pressurized water on demand, tied in with the home battery system. The most successful systems are in a dug well or a 6" well casing with fairly stable water level, using the Flowlight Booster Pump suspended above the water." The Flowlight Booster is a non-submersible DC (12 or 24 Volt) rotary vane pump resembling a hydraulic pump. It is used to feed the same conventional pressure tank system that ac pumps use.

How much solar power is required to provide a small family with pressurized water in the New England states? Gottlieb says that two 50 Watt PV modules (≈ $350 each) will power a shallow well booster pump year round. In the sunnier western states less than one module's output will suffice. Energy is stored in deep cycle "golf cart", electric vehicle or marine batteries. A PV powered pressurizing system is far cheaper (and less freeze-prone) than an elevated tank. Conventional "town pressure" averages 40 PSI and that requires a tank 100 feet high!

A water system with a very deep well or one that's distant from the house will often use a low-flow solar pump at the water source. This fills a storage tank placed closer to the house. A DC booster pump then draws from this tank to charge a pressure tank using power from the home's battery system. If it is too costly to install solar pumping on a domestic well, one may compromise by using a generator and an ac pump to fill the storage tank. Once the tank is full, the generator need not be run for several days. The DC booster takes over the job of frequent pressurizing. If irrigation is required around the house, try to place a storage tank high enough to allow gravity flow.

FOR MORE INFORMATION ON WATER SYSTEM DESIGN refer to Windy Dankoff's previous article "AN INTRODUCTION TO SOLAR WATER PUMPING" in HP#5 (back issues still available).

Solar Tracking

Where peak water needs occur during the sunny summer months, consider a solar tracker. A tracker is a special PV mounting rack that follows the path of the sun. Trackers increase daily output by up to 50% in the summer (less in winter). This increase matches the increased need for water in the summer by lengthening the effective solar day. A longer daily pumping period reduces the number of PV modules required while also reducing pump, wire and control sizes (cost). Zomeworks Corp. builds a "Passive Solar Track Rack" that uses only the sun's heat and the motion of fluid to tilt it toward the sun. It is reliable (10 year warranty) and as simple to install as a fixed array.

Back-Up Power

Generators are sometimes used as a back-up power source during prolonged cloudy periods. This may be done in any of several ways. An ac submersible may be mounted to the bottom of a pump jack cylinder and will push water up through the same drop pipe. In a 6" or larger well casing, a submersible may be mounted underneath the solar pump on the same or a separate drop pipe. Or, a generator may supplement a DC solar pump using a simple ac/DC power supply.

Case Study: Philmont Scout Ranch

New Mexico's Philmont Scout Ranch is a good example of successful solar water pumping. The ranch is used as a summertime Boy Scout camp and cattle ranch. The ranch has a wide variety of wells requiring various solutions. In the past, windmills and propane fired generators were used. Now, water is pumped quietly by 13 solar pumps. All 13 systems use solar trackers to maximize summertime water production. Another 7 solar pumps are slated for installation this season. Fifteen other PV systems are being used to power radio communication, lights and refrigerators for remote cabins.

In 1986, after favorable experiences with PV powered two-way radios, Philmont Ranch opted to try a low cost PV pumping system. Gary Richards, staff electrician, was frustrated by the high cost of solar pumping until he ran across an ad for Flowlight Solar Power in New Mexico's rural electric co-op newspaper. Flowlight had the expertise and equipment he was looking for. Now Gary does all the design work himself, attesting to how quickly solar pumping can be learned. To ease remote-site installation, Gary will pre-assemble and wire most of the system in his shop. Then he transports it to the site where he drops the pump in by hand. "Helpers couldn't believe that after they got the old windmill down I was pumping water within 15 minutes."

To date, all the pumps are 12 or 24 volt DC (1/8 to 1/4 HP). None of the systems require battery storage since several day's supply of water can be stored in sealed tanks for human consumption or in stock tanks for cattle and horses. A typical system consists of between two and six 55 Watt ARCO Solar PV modules on a pole-mounted tracker. Summer days are often cloudy in Northern New Mexico. Richards uses "Linear Current Booster" controllers to increase efficiency in low light conditions.

Richards says, "I love the PV pumping systems because they replace the old windmills and generators that require so much maintenance". A maintenance trip on the sprawling 137,000 acre ranch takes at least a half day's travel over rugged roads "if the weather is good." When asked about the maintenance requirements of PV pumping systems Richards replied, "There is very little." Soon all Philmont's remote wells will be solar pumped. New wells are also being drilled in areas so remote that they were considered unusable in the past.

Specifications of a typical Philmont Ranch system

USE: domestic drinking water
TOTAL HEAD: 30 feet
VOLUME REQUIRED: 2000 gallons per day
VOLUME PUMPED: (summer) 2400 gallons per day
PUMP: Flowlight Slowpump model 2507-15
PV ARRAY: 4 ARCO Solar M-55 modules wired for 24 volt
MOUNTING: Zomeworks Track Rack solar tracker
CONTROL: Sun Selector Linear Current Booster
STORAGE: 2000 gallon tank
MATERIAL COST, PUMP & FILTER: $490

SOLAR PV ARRAY, INSTALLED: $1,925
CURRENT BOOSTER CONTROLS: $110
SYSTEM INSTALLATION COST: $150
TOTAL SYSTEM COST (less tank): $2675

Case Study: Oregon SolarJack

To see a SolarJack in action is to experience perfection and balance. The dedicated engineering of Jim Allen, drilling contractor and founder of SolarJack, has transformed the old-fashioned pump jack into a finely tuned machine. Behind the action sits an array of PV modules silently providing the power.

Allen's earliest prototypes are still working after 5 years (some with no maintenance). Today, SolarJack is the most energy efficient low-volume deep well pump on the market. Every detail contributes to its performance. Allen's patented variable stroke mechanism makes the downstroke take less time than the upstroke. This contributes to high efficiency, which means more water per watt of solar power.

The White family of Jacksonville, Oregon is one enthusiastic SolarJack user. Their mountainside homestead is far from the nearest powerline. A 512 foot deep well is 75 vertical feet downhill from their storage tank. After considering a windmill (winds are fickle) or a generator (fuel, noise, maintenance) the Whites chose a SolarJack system. The pump runs quietly without human attention. Installation was performed by the solar system supplier, Electron Connection Ltd., POB 442, Medford, OR 97501 • 916-475-3179.

SPECIFICATIONS: Oregon SolarJack
USE: Domestic, home and garden
TOTAL HEAD: 475 feet
VOLUME REQUIRED: 1000 gallons per day max.
VOLUME PUMPED: 1,170 gallons per day max.
PUMP: SolarJack pump jack at 90 Volts DC
PV ARRAY: 8 Kyocera 48 watt modules
MOUNTING: Non-tracking
CONTROL: SunSelector Linear Current Booster
STORAGE: 3,600 gallon tank
MATERIAL COST, PUMP: $6,451 (including freight, concrete)
SOLAR PV ARRAY, INSTALLED: $3,088
PUMP INSTALLATION COST: $658
TOTAL SYSTEM INSTALLED COST (less tank): $10,197

Solar Pump Manufacturers
A.Y. McDonald (medium to high volume DC submersible & jet pumps)
POB 508, Dubuque, IA 52004 • (319) 583-7311

Flowlight Solar Power (low volume surface and submersibles, booster pumps)
POB 548, Santa Cruz, NM 87567 • (505) 753-9699

Grundfos (high volume submersible pumps)
2555 Clovis Ave., Clovis, CA 93612

SolarJack (jack pumps, centrifugal and low volume submersibles)
325 E. Main, Safford, AZ 85546 • (602) 428-1092.
Contact your favorite PV dealer for advice and pricing.

About the Authors

Windy Dankoff is owner of Flowlight Solar Power, a manufacturer of PV pump systems and a supplier of remote home photovoltaic systems. He began working with wind generators in 1975 and has been installing solar pumps since 1980.

Steve McCarney teaches at the Colorado Mountain College PV program and is with Appropriate Technology Associates (ATA), offering PV design, installation, and training services. ATA is located at 410 Garfield Ave., Carbondale, CO 81623. Phone (303) 963-2682.

~~~~~~~~~~

Get yer ducks in a row…

Before you can specify a PV/Pump system you should know:

- WELL DEPTH (or description of water source)
- DEPTH TO WATER SURFACE -- Does it vary? If so, how much?
- YIELD OF WELL, estimate in gallons per minute
- TOTAL VERTICAL LIFT from water surface to storage tank/pipe outlet
- SIZE OF CASING (inside diameter)
- QUALITY OF WATER (silty, mineralized)
- WATER REQUIREMENTS in gallons PER DAY, according to season
- APPLICATION for water: Home? Livestock? Irrigation?
- Is PRESSURE required (home, sprinkling)?
- Can a STORAGE TANK be located higher than point of use (easily)?
- Is system to be located near a home/battery? Distance?
- Elevation above sea level (determines suction limitations)
- Complex terrain? draw map or diagram
- DESCRIBE EXISTING EQUIPMENT for pumping, distribution, storage etc.
~~~~~~~~~~

Passive Solar Hot Water

Kathleen Jarschke-Schultze KB6MPI

My husband and I live on the Salmon River in very rural Siskiyou County, Northern California. Our cabin is about half way between two of the three historic mining communities located on the river. All three towns and the mountainous areas surrounding them are off the power grid. We use primarily microhydro and are now incorporating solar into our system. In the past we've heated our house and water with wood. There are portions of each summer here when high fire danger allows no stove fires. You can't even use a chainsaw in the woods then. Just because we can't have stove fires doesn't mean we can't have hot water. Supplementing our wood stove heated water system we added an amazingly simple passive solar water heater.

Materials Needed

- one 4 ft. X 4 ft. square piece of 1/2" plywood
- 100 ft. of 3/4" dia. black PVC pipe
- 24 ft. of 2"x 2" lumber
- 6p nails
- two ball valves
- roll of clear plastic
- plumbing fittings to hook into your water tank
- one 5 1/2 in. X 5 1/2 in. square of 1/2" plywood
- 4 square feet of aluminum litho press sheets
- four 3 foot lengths of baling wire
- staples
- two hose clamps
- length of hose
- pipe insulation

Design and construction of this heater are simple. Use the materials you have on hand.

It's the IDEA that counts. In order to get an idea of amounts and lengths needed, I am giving you the measurements of our solar water heater. But, remember, this system is very easy and adaptable to your space, materials and needs. So have fun.

Assembly

The base is made up of four 4 ft. long 2" by 2" nailed into a square. This is covered by a 4 ft. square piece of 1/2" plywood, covered with shiny aluminum litho press sheets, available for most printers or newspapers . Aluminum foil will also work, but litho sheets last more than one season. Slightly in from the edges (1-2") are four 43" long 2" by 2"'s cut at a 45° angle on both ends, see diagram, attached in a pyramid shape and affixed to a 5 1/2" square of plywood at the top. Nail a 6p nail into each 2" by 2" about 3" up from the bottom. Here is where the obligatory baling wire comes in. Twist the end of a length to each nail, then start coiling the PVC pipe around the bottom of the pyramid resting on the protruding nails. When you have four coils of PVC, place a nail on each 2" by 2" directly above the last coil. Pull the baling wire up tightly and wrap it around the nail to make the coils firm against the pyramid (see diagram). Continue this coiling and securing 'til you reach the top square of plywood. It would be best if the PVC then extended unbroken to the metal intake atop the water tank.

Location

Place the pyramid as close to your water tank as possible while still allowing full southern exposure. The top of the pyramid must be lower than the top of the tank and the bottom of the pyramid must be the same height or lower than the bottom of the tank (see diagram). For maximum efficiency insulate the top pipe from the pyramid to the tank. Make sure the pyramid platform is level. Our system has a ball valve in the top pipe where it changes to metal pipe to enter the tank. This enables us to shut off the system in the evening to keep the hot water from recirculating and cooling. Also the hose and ball valve from the bottom of the tank to the PVC at the bottom of the pyramid allows us to turn off the valve, unhook the hose and drain the system for winter. The finishing touch is to cover the outside of the pyramid with clear plastic and staple it down. We have to replace the plastic every year, as it deteriorates in one season's use.

Conclusion

On a summer's day we get about 10 gallons of very hot water. It helps if, in the morning, you run the hot water faucet for a minute to get the flow going good. In building this system you can really let your homesteading adaptability come into play. My friend Sarah, who did the diagrams for this article, and I built a pyramid for her house. Utilizing materials we could find there, we substituted 2" by 4" for the 2" by 2". The only practical space to place the pyramid was a 66" by 30" space, right off her deck, so the unit became rectangle. To increase efficiency we placed a reflective backplate behind the pyramid to gather more solar radiation. The more black PVC you can get on your pyramid, the more hot water you will have. Within a few basic rules this design is limited only by your needs and imagination.

Sustainable Energies Research Institute

Art & Sylvia Krenzel

We are grateful to the Home Power crew for their quiet urging to discuss "the dream which is driving our actions". In talking with others, we have found that the knowledge and information to successfully live a self-sustaining lifestyle is available, but widely scattered. We are dreaming of establishing a school for learning self-sufficiency technology and self-sustaining lifestyles. Our goal is to start a school where we can integrate nature, technology and humanities in a group setting.

The School

Weekend workshops and conferences are planned, as well as longer term courses. Participants will be involved in a wide range of topics such as: energy efficient architectural designs, renewable energy technologies, innovative food production, low impact agricultural methods, cottage industry management, humanities and ecology. These subjects will be taught by qualified in-resident staff as well as visiting instructors.

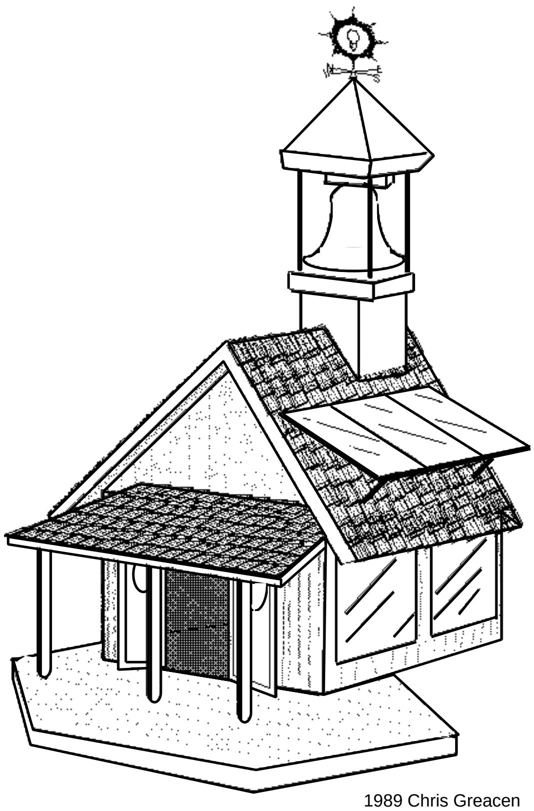
All faculty, administrators and students will work together in the daily tasks necessary for the school's operation. In this way, everyone will experience the broad spectrum of skills necessary in a self-sustaining environment. The over-riding concept will be the integration of theory and actual hands-on experience. No Ivory Towers here.

The school will be powered by renewable energy- it will practice what it preaches. Students will have real hands on experience and will work with instructors to design and build solutions for their personal situations.

A Peaceful Location

We are now searching for a peaceful location with a wide range of natural resources so we can demonstrate a living mix of nature and technology. Current plans envision a central conference facility providing a meeting room for lectures with smaller rooms for a more "one on one" learning environment. Other buildings planned are a community kitchen/dining facility, recreation areas, shops and office space. Staff and guest housing will be remotely dispersed but located within easy walking distance of the main buildings. These houses will provide working examples of alternative building technologies including domes, bermed buildings, underground structures, super insulated buildings, etc…

The plans also include space for pasture, fish ponds, organic gardens, orchards, and innovative concepts in small scale food production such as greenhouses, hotbeds, and aquaculture. Food cropping should be of sufficient quality to meet the needs of in-resident staff and also those who are attending conferences, workshops and classes.



1989 Chris Greacen

Finances

The school will be operated as an educational organization deriving its main income from student tuition, donations and rental of the conference facilities to groups. Some income could also be expected from surplus food production and other in-residence cottage industries.

We thank the crew at Home Power for their continued support of the school. We hope that this article will begin to locate people and resources to carry the concept of the Sustainable Energies Research Institute into a reality.

You Can Share, too!

If you have an interest in participating in any way, whether it be by attending, teaching, or contributing finances, effort or time, or whatever else you feel may help the project, please contact us. **Now it is time for your input.** Please use the form on page 29 for easy access.

Art & Sylvia Krenzel
POB 117, Greenview, CA 96037.
telephone: 916-468-2349

The driving force behind this project is Art Krenzel, currently working as a Registered Chemical Engineer. He has established an insulation manufacturing company which recycled material to conserve home energy. As an extension to this company, he also started a National Training School for advanced energy saving techniques. Starting from the area of thermal efficiency, he now researches alternative energy production and resource conservation. We are supporting this project because we believe it's necessary, relevant and beneficial. We have confidence that Art and Sylvia can accomplish such a difficult project . RP

How to wire an inverter to a 120 vac mains/breaker panel

Richard Perez

Getting the inverter's power output into a conventional 120 vac mains panel can be a problem. Unless the wiring is properly connected and sized, the inverter's power will not be effectively transferred. So here's the straight dope about wiring your inverter to a mains panel that was designed for conventional grid power input. These panels are found in all "electrically standard" homes and manufactured housing.

The Marriage of Inverter to Mains

If you're reading Home Power, then you probably are already familiar with inverters. These marvelous devices change the low voltage DC stored in our batteries into 120 vac, 60 cycle power. They allow us to use PV produced and battery stored energy in conventional appliances. The inverter's power output, while not an exact replica of that supplied by the power company, is close enough to run almost all conventional 120 vac appliances. Just like downtown.

Now the mains panel is a different matter. This piece of electrical equipment lurks in basements, closets, and other dark, unfrequented places. The function of the mains panel is to connect your building with the conventional commercial power grid. It provides a terminus for your building's wiring. Within the mains panel each 120 vac circuit, via its individual circuit breaker, connects with the main power input. Hence its name, mains panel.

Our mission is to wed the inverter, from the world of renewable energy, with the mains panel, from the world of costly, pollution ridden, commercial grid electricity. Maybe not a marriage made in heaven, but certainly one made in the sunshine. Consider yourself an ecological/electrical match maker.

Getting the Power out of the Inverter

All high quality inverters offer us two ways to connect to their output- via a plug or via hardwired terminals. Let's look at plugs first. The male plugs are a standard 3 prong, grounding, 20 Ampere plugs known in electrical jargon as "cord caps" (don't ask me why). You can use just about any male plug, but get one that is of high quality. This means strong prongs, anti-corrosion plating, and a solid case. A high quality cord cap will cost around $5 to $7 and is worth it. The inverter's entire output is passing through this plug, so it's not the place to save a buck. Connect the plug as follows. The GOLD colored terminal of the plug is HOT and connected to the BLACK wire in the output cable. The SILVER colored terminal of the plug is COMMON and connected to the WHITE wire in the output cable. The GREEN colored terminal of the plug is GROUND and connected to the BARE copper wire in the output cable.

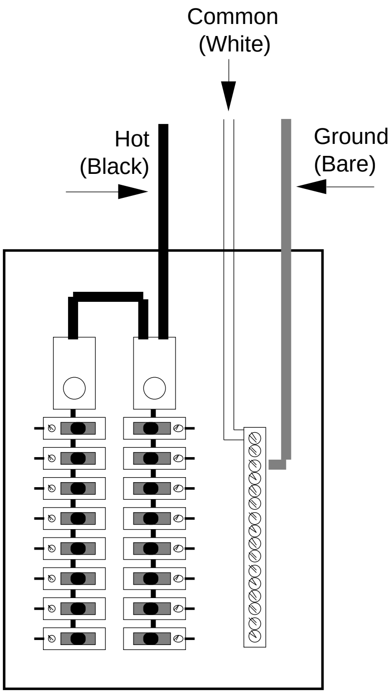
You may also have a hardwire output for your inverter. This output consists of three electrical terminals that will accept either bare wire ends, or ring connectors. Wire these according to the manufacturer's instructions on your particular inverter. Here's some info on two of the most common types of inverters. The Trace inverters offer their hardwired output via a barrier strip under their Plexiglas window. The terminus is located in the upper right hand corner of the window just below the standby input line. Trace supplies ring connectors and an Allen wrench with every inverter. These allow you to install lightweight wire into the barrier strip. The Heliotrope inverter supplies three large & easily used connectors on the lower left hand side of their main PC board. These connectors will accept 10 gauge wire ends directly. Once again the wiring scheme is the same: HOT to BLACK wire, COMMON to WHITE wire, and GROUND to BARE wire.

Inverter to Mains Panel Wiring

The wire transferring the inverter's power to the mains panel must be of sufficient size to handle the current over the distance without excessive losses. If the inverter to mains panel wiring distance is less than 70 feet, then 12 gauge copper will will do the job at 98% or better efficiency. If the inverter to mains panel wiring distance is about 120 feet, then 10 gauge copper wire will be 98% efficient. These facts are computed on the round trip wiring distance (two conductors) and half of these distances is the actual physical distance between the inverter and the mains panel. Use conventional ROMEX cable for this purpose, like NM12/2 with Ground. This cable contains three solid 12 gauge copper wires: one with black insulation, one with white insulation, and one without insulation. For longer distances, use the 10 gauge equivalent, NM10/2 with Ground. If the cable is exposed to sunlight or buried, then use cable with USE (Underground Service Entrance) insulation. The USE insulation on the outside of the cable will not photodegrade in sunlight, or rot in moisture.

Connecting to the Mains Panel

Route the wire into the mains panel from its top. Connect the hot (BLACK) to the main input breakers. Connect the Common (WHITE) and the Ground (BARE) to the wiring terminal beside the rows of circuit breakers. See the diagram to the right.



The mains panel is designed for commercial power input. Each row of breakers (and there are two), is connected to a 120 vac leg of the grid input power. Together, these two 120 vac legs make 240 vac. Well, the inverter just makes 120 vac. In order to energize the second set of breakers, we must add a jumper between the two main input terminals as shown in the diagram. This effectively converts the mains panel from 120/240 vac operation to just 120 vac operation.

The terminals where the common and ground wires are all connected should be grounded. This is the main system ground for the 120 vac distribution system. This terminus should be connected, with 6 gauge bare copper wire, to a metallic rod driven at least six feet into the ground.

And they lived happily ever after…

The inverter is now wedded to the mains panel, and all 120 vac circuits are energized. As with many weddings there are leftovers. Most weddings produce an excess of toasters and cuisinarts, but in this case the leftovers are circuit breakers. The inverter contains its own output circuit breaker, there are the main breakers at the top of the panel as well as the individual breakers for each ac circuit. There are actually three circuit breakers in series with every circuit. More than enough to please even the fussiest building inspector.

It's Gotta Be Spring

Brian Green N6HWY

Winter is over and Mother Earth is waking up. "Spring hath sprung", saith the sage. As winters go it was a good one; lots of snotty roads, getting stuck in 3 feet of snow doing the photos for HP 9 and tweaked antennas from snow and wind. Most Ham magazines feature antennas in their May issue, so what better time to answer a few questions readers have sent in.

What's Up - TV & FM

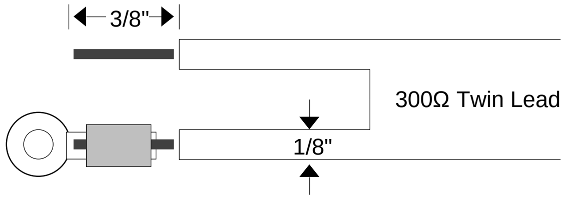
One of the most asked questions is how to improve TV and FM reception. I started fooling with TV antennas in '74. I am always after the better picture and more channels. There is more to life than just watching the local channel. Remember this is just a guide, one size does NOT fit all. Get the best you can afford. If you live in a fringe area, the biggest antenna on the highest mast is best.

My System

Take one Radio Shack top of the line VHF only, V185 antenna (RS part#15-1654, $59.95). Set it atop of a 36 foot, four section telescoping mast (RS#15-5067, $51.95) and you have the start of a good system. I attached the mast to my trailer with wall brackets (RS part#15-886, $8.99) with my 2 meter Ham antenna on top and the TV antenna just below. I just knew I'd hear the world or at least Southern Oregon.

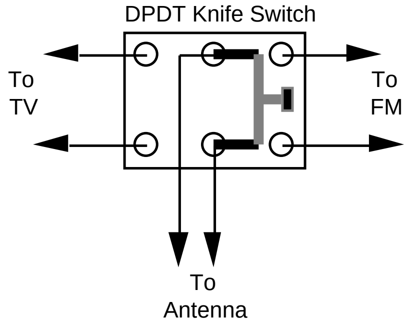
There are two ways to connect the antenna to the TV. One is coaxial cable and the other is 300 Ω twin lead. Don't go cheap on feed line, get the good stuff. Belden makes high quality feedlines. I used 300 Ω twin lead. Twin lead has two advantages; it's low loss and inexpensive. On the down side it is very lossy when it gets wet. You can avoid this by giving it a good paste waxing. When you install twin lead, keep it at least 4" away from any metal. Stand-offs will do this job nicely when placed about 4 feet apart. To help cut down on ghosts put a few twists in the twin lead between the stand-offs. Solder spade connectors onto both ends of the twin lead. Prepare as in the figure below, being careful not to nick the wire. A few wraps of electrical tape or shrink tubing will finish the job.

Now if you are like most of us around here you also enjoy good sounds. Did you know that your TV antenna comes equipped with an FM antenna? The FM band is located between TV channels 6



& 7. One way to share the RF energy coming down the twin lead is to switch the twin lead to a double pole, double throw switch, *DPDT* (RS part #275-1537).

Run a piece of twin lead to your TV. If you are using a stereo with 300 Ω inputs use another piece of twin lead to feed the stereo. If it's a 12 Volt car radio you need a transformer (RS part#15-1140),



AKA 4:1 balun to convert 300 Ω twin lead to 75 Ω TV coax. Crimp an "F" connector on one end and solder a Motorola antenna plug on the other end. You can't solder the aluminum foil shield to the outside of the plug, but you can solder the 4 steel wires.

This system has given me all of the local translators and all the distant (≈100 mi.) TV stations. As for FM, it's my choice, anything within 150 miles is fair game. If this doesn't do the job for you, then use an antenna mounted pre-amp and 75 Ω coax. Radio Shack's mast mounted preamp (RS#15-1108) works well. If you use an ac powered (via the inverter) pre-amp and rotor, unplug them when not in use. Their transformers are always on. As an aside, the same can be said about some other "phantom loads" like instant on TV's and boom boxes - another electron saved!

Weather Radios & Scanners

Two other receivers that are nice to have around the homestead are weather radios and scanners. Weather radios let you stay on top of the latest forecast and road conditions and are inexpensive. This information can mean the difference between sitting by a warm fire or cooling your heels on a snowy mountain pass. Radio Shack has several weather radios that work well.

A scanner is a very broad banded receiver that can quickly sample many frequencies. The least expensive are crystal controlled, a crystal for each frequency. The more expensive scanners use synthesized receivers and require no additional crystals. The top of the line models will search for active frequencies and store the information. The Bearcat BC145XL that I have needs to be programmed with the frequency you want to listen to. I have a list of active frequencies from the local Radio Shack, which covers police, sheriff, fire, weather (NOAA), BLM, forestry, ham, etc. As with TV and FM, scanners need a good outside antenna to work their best. It should be as high as practical.

Other Notes

Jim Hale in Arkansas has a cordless telephone working 1/2 mile using TV antennas....sounded real good when I talked to him a few weeks ago. Speaking of telephones, I can be reached at 916-475-3401. It's the first phone I've had in almost 20 years. What fun! Or you can write me at POB 130, Hornbrook, CA 96044.

73's (Best Wishes),

Brian

Sources

AES (Amateur Electronic Supply), Las Vegas, NV • 1-800-634-6227, Milwaukee, WI • 1-800-558-0411. A very good catalog, good prices on scanners, weather radios, scanner antennas, preamps and ham gear.

Ham radio magazines are found in most libraries and book stores and are a wealth of info on antennas and feedlines. My favorite is "73" Magazine.

Real Goods, Backwoods Solar Electric, and Alternative Energy Engineering have 12 Volt TV/FM pre-amps.

Home Power Magazine is FREE

Free to those with US ZIP CODES ONLY. For international subscriptions see page 53.

If you want to receive Home Power Magazine, please completely fill out our free subscription form below, fold it up, tape it, put a 25¢ stamp on it & drop it in the mail. **You need only do this once**. Once you have responded to Home Power, we will send you each and every subsequent issue free. We encourage you to use this form to communicate with us. Please check the box(s) below that apply to your communication. This helps us deal with the mail. For those wishing **Back Issues of Home Power**, please see page 53.

☐ New Subscription ☐ Change of Address Include old Address ☐ New Info on your System ☐ Other

PLEASE PRINT CLEARLY. GIVE YOUR COMPLETE ADDRESS.

NAME ______________________________

STREET ______________________________

CITY ______________________ **STATE** __________ **ZIP**______________

The following information regarding your usage of alternative energy will help us produce a magazine that better serves your interests. This information will be held confidential. Completion of the rest of this form is not necessary to receive a free subscription, but we would greatly appreciate this information so we may better serve you.

FOR OUR PURPOSES WE DEFINE ALTERNATIVE ENERGY AS ANY ELECTRICAL POWER NOT PRODUCED BY OR PURCHASED FROM A COMMERCIAL ELECTRIC UTILITY.

I NOW use alternative energy (check one that best applies to your situation).

- ☐ **As my only power source**
- ☐ **As my primary power source**
- ☐ **As my backup power source**
- ☐ **As a recreational power source (RVs)**

I want to use alternative energy in the FUTURE (check one that best applies).

- ☐ **As my only power source**
- ☐ **As my primary power source**
- ☐ **As my backup power source**
- ☐ **As a recreational power source (RVs)**

My site has the following alternative energy potentials (check all that apply).

- ☐ **Photovoltaic power**
- ☐ **Water power**
- ☐ **Wind Power**
- ☐ **Other**______________________

I now use OR plan to use the following alternative energy equipment (check all that apply).

NOW	FUTURE		NOW	FUTURE	
☐	☐	**Photovoltaic cells**	☐	☐	**Gas/Diesel generator**
☐	☐	**Wind generator**	☐	☐	**Batteries**
☐	☐	**Water power generator**	☐	☐	**Inverter**
☐	☐	**Battery Charger**	☐	☐	**Control systems**
☐	☐	**Instrumentation**	☐	☐	**PV Tracker**

FOLD HERE

& TAPE

Please write to us here. Tell us what you liked and didn't like about Home Power. Tell us what you would like to read about in future issues. Thanks for your time, attention & support.

FOLD HERE

Return Address

Place
25¢
Stamp
Here

Home Power Magazine
Post Office Box 130
Hornbrook, CA 96044-0130

REPLY SHEET

The Sustainable Energies Research Institute is seeking your input to determine the level of interest and the mix of courses which you feel should be offered.

Please fill out this tear-out form indicating how the school might benefit your efforts to become more self-reliant. Your reply is necessary to help us design the school to meet the needs of the participants. Thank you for your help.

NAME ____________________

ADDRESS ____________________

CITY ____________________ STATE __________ ZIP __________

I would like to help the school by:

☐ Attending ☐ Instructing ☐ Fund Raising ☐ Advertising

☐ Contributing Labor ☐ Contributing Funds ☐ Other

Do you have particular skills or knowledge which you feel would be valuable to the school?

Do you feel college accreditation of courses is important?

What do you feel is the optimum course length for you?

☐ 1 Day ☐ 3 Day ☐ 5 Day ☐ 7 Day ☐ 14 Day ☐ 30 Day

What do you feel would be a fair tuition for the course (including room and board)?

$ ____ 1 Day $ ____ 3 Day $ ____ 5 Day $ ____ 7 Day $ ____ 14 Day $ ____ 30 Day

COMMENTS:

Skills to share	I want to learn	
☐	☐	Alternatives in home heating and conservation
☐	☐	Alternative power sources and conservation
☐	☐	Resource efficient construction
☐	☐	Gourmet self-sufficiency
☐	☐	Cottage industries
☐	☐	Solar architecture

FOLD HERE & TAPE

☐	☐	Humanities- spirit of community
☐	☐	Humanities- consensus decision making
☐	☐	Humanities- other
☐	☐	Efficient food preservation
☐	☐	How to live with construction codes
☐	☐	Integrated self-reliant experiments
☐	☐	Agriculture & gardening
☐	☐	Other (please specify)

Thank you for your time in filling out this form.

FOLD HERE

Return Address

____

____

____

Place
25¢
Stamp
Here

SUSTAINABLE ENERGIES RESEARCH INSTITUTE

Post Office Box 117

Greenview, CA 96037-0117

Ariesun- A Solar Powered House

Richard Perez

Using solar energy in our homes is far from new. Native Americans oriented their cliff dwellings to catch the winter's sun thousands of years ago. Over the course of the last few centuries technology has given us the tools to make better use of the sun's energy in our homes. The building described here uses the environment outside to create an efficient and harmonious living space inside. Solar heating, cooling and photovoltaic electricity combine to make this home not only energy efficient and self-sustaining, but also beautiful, comfortable and affordable.

Ariesun

The first operational building of the Alcyone Light Centre, Ariesun- the "Bioshelter" is nearing completion. Ariesun is a school of ecological studies and is now in use for workshops and residence. Lawrence M. Schechter is the solar architect and principal builder of Ariesun, located at about 42°N. latitude in Hilt, California.

The design for this 3,300 square foot building centers on maximum southern exposure and minimum northern exposure. Its south side is open to sunlight, 56 feet wide and three stories tall. The north side is 35 feet wide, one story tall and partially sunken 4 feet into the ground. The very design and orientation of this building make passive solar heating possible.

A solar heated greenhouse, south of the living area, provides about 80% of the passive heat for the building. This house was designed to circulate the air heated within the greenhouse throughout the building- without the use of fans or electricity. The system uses the fact that hot air is less dense than cold air to create natural convective air circulation. A fish pond is located outside, south of the greenhouse, and increases the low angle winter solar insolation entering the greenhouse ≈60%. Back up heating is a wood stove, connected to hot water circulating coils below the tile ground floor.

Lawrence's design uses 12 inch thick rammed earth walls to store heat and insulate the ground floor of the building. The second floor walls are 2"X6" frame construction and insulated to R-19 with fiberglass. The roof is heavy timber construction covered with 2 inch polystyrene insulation below cement tiles. The majority of the building's insulated windows face south for solar heating. Operable vents alongside windows provide for cross ventilation and control the greenhouse's impact during the summer. The greenhouse is also equipped with two wind powered turbine vents. In as little as a 4 MPH breeze, these vents can change all the air in the greenhouse in about two minutes. During the summer, the rammed earth walls and tile floors keep the building cool. Windows and vents, located to catch the night's breezes, cool the thermal mass. This keeps the building's interior about 75°F when outside temperatures approach 100°F.

Active Systems

Lawrence's design uses an energy tower on the east side of the building. This tower's south facing roof has a 55° slope for

Left: A view of Ariesun's south exterior showing the greenhouse. We are looking northeast in this photo. Note the two wind powered turbine vents on the greenhouse.

Above: Arisun looking southeast. Note the energy tower on the east side of the house. This tower holds the domestic hot water and photovoltaic systems.

Photos by Brian Green.

operation of solar hot water collectors and photovoltaic panels. All the water heating and electrical equipment are compactly located in this tower. The concentration of the utilities makes for simple, inexpensive interconnection and maintenance.

The hot water plan calls for using two 4 by 8 foot solar collectors. This system is augmented by an on-demand type propane fired water heater adjacent to the centralized plumbing.

The electrical plan for the building (as yet uncompleted) calls for using four 48 Watt Kyocera PV modules to recharge a deep cycle battery bank of 440 Ampere-hours at 12 VDC. The batteries and Trace PV controller are located in the energy tower directly below the PV panels. This not only reduces wire losses, but makes the system simpler and cheaper to wire. Lawrence's effective solar home design has greatly reduced the need for artificial lighting. This house doesn't have any dark corners. A Trace 2012 inverter will be used to power kitchen appliances, office equipment and general lighting. A back-up 12 VDC lighting system will be powered directly from the 440 A-hr. batteries.

This building minimizes its impact on our environment. Concentration of active systems uses less materials and costs less to build. Using solar energy as the prime power input reduces the building's demand on our rapidly diminishing fuel supplies. Ariesun used only one cord of firewood this past winter. The greenhouse provides food as well as heat. The material and building cost of this building are within a few percent of a non solar building that would eventually cost much more to build and operate.

The entire building displays an integrated approach to ecologically minded living. The requirements of life are thoughtfully met, with an appreciation of the delicacy and interdependency of nature. There's much more happening at Ariesun than just applied solar energy. I'll let Lawrence tell you in his own words…

A Centre for Ecological Studies-

the Alcyone Light Centre

Lawrence M. Schechter

Living in balance in our world requires a transformation in our treatment of the earth and its ecology. Our technology must be used to serve the balance of nature rather than to destroy it. Appropriate technology may be defined as being: a) sustainable– it has a limitless future, b) fair- it involves equitable distribution of resources, c) interdependent– it responds to the links of health, work, consumption and the environment, d) nondestructive– it avoids damage to the earth's irreplaceable resources, e) pollution free– it avoids harmful effluents, f) cyclic– it recognizes that life is a continuous cycle of exchange, and g) it is based on life-cycle cost to the interdependent systems and lays less stress on the acquisition of material possessions.

The Centre for Ecological Studies seeks to teach by example. Starting this summer, the Centre will offer a series of programs regarding integral environmental design based on renewable energy and ecological responsibility. The program includes active solar systems within an integrated environment derived from passive solar design and numerous factors that affect well-being, as well as economy.

Schedule of Programs - Summer/Fall 1989

A. **Solar– Passive and Active Systems**

Section 1: July 30 (7pm) through August 4 (4pm): **Site planning and passive energy building design.** Principal Instructor: Lawrence Schechter, Architect. Land Planning: design principles and application, including permaculture, organic gardening, composting, working with Earth's energy currents. Building Design & Construction: general principles of a good plan, configuration for effective functional relationships, spacial amenities, energy efficiency. Construction techniques include owner/builder options, natural, renewable building materials and nontoxic systems. Passive Energy Design: principles and methods of design to maximize passive heating, cooling, daylighting and ventilation, including design exercises and energy calculations.

Section 2: August 4 (7pm) through August 6 (4pm): **Active Solar Systems**. Principal Instructor: Richard Perez. Photovoltaic Systems sizing, choice of equipment, costs, and life-cycle amortization. Under discussion hands-on installation of: PVs, inverters, batteries, appropriate appliances, controls, instrumentation, wiring, troubleshooting and maintenance. Also covered will be PV powered radiotelephones and solar hot water systems.

B. **Shared Living Community Housing**. August 25th (2pm) to August 27th (2pm): Explore organization and housing design. Principal Instructors: Ken Norwood, Architect (Shared Living Resource Center, Berkeley, CA); Lawrence Schechter, Architect. Please send for flyer for more information.

C. **Energy- Passive & Active Systems**. November 6th through 12th. Similar to program A in August, except that hands–on experience will include aquaculture in a solar greenhouse and solar hot water systems.

Location: Alcyone Light Centre, 1965 Hilt Rd., Hornbrook, CA 96044 • 916-475-3310.

Tuition: Two day programs: $120 ($180 for couples), Five day programs: $250 ($375 for couples), Seven day programs: $300 ($450 for couples).

Board/Lodging: per person, including 3 vegetarian meals daily, $25 per day/dormitory; $15 per day camping or RV.

Registration: Please send name(s), address, telephone number and accommodations needed with a deposit of 50% of tuition to assure reservation. Space is limited to the first 20 people. Preference given to 7 day program reservations. Travel directions and assistance with car pooling, plus list of suggested reading material will be sent prior to date of program. Alcyone is accessible by air to Medford, OR or Greyhound to Yreka, CA. Approx. 5 hour drive to Portland or 6.5 hours from San Francisco.

If you are interested in being on our mailing list, please indicate. If you would like a brochure on Alcyone's overall objectives as a spiritual/educational foundation, please include $3.

Lawrence Schechter: Architect with over 25 years professional experience, over ten years in Solar Architecture. Has designed many distinguished solar buildings in conjunction with sacred geometry and earth energies. Co-founder with his wife, Sylvia, of the Alcyone Light Centre, a non–profit, tax exempt foundation. In addition to his Architectural practice, Environmental Harmonics, he offers consultation and educational programs on Integral Architecture and design. Contact:

Lawrence Schechter, 1965 Hilt Road, Hornbrook, CA 96004 or call: 916-475-3310.

Basic Principles of Solar Architecture

Our shelters are made in nature, from natural materials, and they are subject to the rigors of nature- from January blizzards to July furnaces. Built on and from the earth, subject to the forces of earth, they become part of earth's ever changing habitat. Our shelters should be designed to adapt to the changes of the earth, to use what nature offers: the sun, wind and earth, instead of guzzling energy, to maintain a stable environment. The basics of solar architecture - techniques for creating a comfortable environment working with nature - are straight forward. While reading these ideas, refer to the Ariesun drawings for an example of how they are implemented in an actual building.

SITE

Become familiar with the energy flows of your surroundings. Investigate the nature & relationship of the lay of the land, water courses, vegetation, soil types, wind directions, and exposure to the sun. A site suitable for solar design should balance & complement these elements. It must have unobstructed exposure to the sun from 9 am to 3 pm during the heating season. Obtain a Solar Chart for your latitude. This simple tool is a plastic sheet showing the sun's trajectory. With it you can accurately estimate shading through the day and year.

SOLAR RADIATION

Insolation is solar radiation hitting walls, windows, roofs and collector surfaces. Insolation comes in three forms: **direct** from the sun, **diffuse** from the sky, and **reflected** from terrain and vegetation. Some of this radiation is adsorbed by the building and is stored in **thermal mass**. This stored heat is then radiated to the interior of the building. Thermal mass in a solar heating system performs the same function as batteries in a solar electric system. Both store solar energy, when available, for later use.

HEAT FLOW

The rate of heat flow is based on the temperature difference between heat source and the object to which the heat flows. Heat flows in three ways: **conduction-** heat transfer through solid materials, **convection-** heat transfer through the movement of liquids or gasses, and **radiation-** heat transfer without a material medium. All surfaces of a building lose heat via these three modes. Consult building handbooks for the conduction properties of various building materials. Good solar design works to minimize heat loss and maximize efficient heat distribution.

HOUSE PLANNING WITH SOLAR PRINCIPLES

Heating

Orient due south the main solar insolating spaces, i.e. greenhouse, and/or main daytime activity areas. Provide glass that is open to the sun patterns during the winter. Maximize solar insolation by facing about 80% of the windows to the south, and virtually none to the north. Use multiple pane glass in all windows.

Provide thermal mass including masonry floors, walls and water storage to absorb ambient heat during the day and release it at night. Size the mass to provide at least 2 to 3 days of heat storage for the building. Insulate the building to minimize heat loss through windows, walls and roof.

Work with the natural heat flow. Hot air rises, so place some activity areas on a second floor or raised split level to draw heat up from a lower collector area and across other areas. Provide buffer areas to the north of the building to lessen the impact of the winter's cold. Use unheated rooms, or partially heated spaces such as utility rooms, vestibules and storage areas. Use a vestibule on doors to the exterior.

Vestibules cut heat loss and provide a buffer zone between the exterior and the interior. Vestibules are ideal for dressing & for storing outdoor clothing and boots.

Cooling

A passive solar building needs cooling as much as heating. One of the best, time proven methods of cooling is thermal coupling with the earth's constant 55°F. to 60°F. temperature. Dropping the ground floor at least four feet into the earth provides a more even exterior temperature which aids cooling as well as heating. Adequate structural engineering, drainage, and damp proofing are essential in below ground areas.

Thermal isolation is the best and most economical way to temper the building's environment. Insulate with R values given by the uniform building code. Even greater insulation may be appropriate in some areas. Using the earth's thermal mass keeps the house at a reasonable temperature, and so does good insulation.

Use appropriate shading devices such as overhangs, movable insulation, and vegetation to shade the summer sun. A two foot overhang is generally standard for 35° to 45° latitude.

Provide for cross ventilation by orienting opening windows to prevalent wind directions. Extract unwanted heat via operable windows at high points within the space. Vents can double as clerestory windows for natural daylighting.

Avoid skylights that face the sky without adequate shading for the summer sun. A south facing dormer or roof top monitor with summer shading is best, especially if it vents to the outside.

Strive to make several uses of each area. For example, solar greenhouses will provide food in addition to heat. Open planning provides flexibility of use while moving natural daylighting, heating, or cooling effectively throughout the building.

SOLAR ARCHITECTURE & ACTIVE SYSTEMS

The building should naturally orient solar hot water and PV panels due south. Tilt thermal collectors at ≈55° (from horizontal) to maximize winter heat collection. Heat collectors should be thermally locked with the roof. Nontracking photovoltaics receive the most yearly insolation when tilted at an angle, from horizontal, equal to the building's latitude. PVs should NOT be thermally locked to the roof. Design the building's roof to

The floor plans for Ariesun.
Architectural drawings by Lawrence Schechter.

accommodate these angles and southern orientation as integral aspects of the building. See illustration.

Locate hot water collectors and PV panels as close as possible to their main areas of use. Concentrate these areas of use. For example, putting the bathrooms and kitchen close together economizes on their installation and minimizes energy loss. All appliances should be selected with efficiency as the prime criterion.

Things that Work!

Home Power tests Hydrocaps

One of the perpetual chores in home power systems is watering the batteries. These large lead-acid cells always seem thirsty for distilled water. As these batteries recharge, some of their water escapes. Periodic watering of these large cells is essential for battery survival. Failure to do so results in the early demise of these expensive batteries. Hydrocaps are devices which greatly reduce the battery's water consumption and also offer vital safety and operating features.

The Lead-Acid Recharging Process

The electrolyte in lead acid batteries is a dilute (≈25%) solution of sulphuric acid in water. As the lead-acid cell reaches a full state of charge, some the water in the electrolyte is broken down into hydrogen and oxygen gasses by the recharging current. These gasses escape from the vent on the top of each cell. This process, called "gassing", accounts for the water lost from the cells. The actual amount of water the cell loses during recharging depends on several factors. High temperatures (>90°F), high rates of recharge (>C/20), and elevated voltage limits (>2.44 VDC per cell) all increase the amount of gassing that occurs during the recharging process.

If all the cells in a lead-acid battery are to be totally refilled and equalized, then a certain amount of gassing will have to take place. It's up to us to deal with this situation. First, we must add distilled water to the cells to make up for the water hydrolized into hydrogen and oxygen. Second, we must deal with the potentially explosive mixture of hydrogen and oxygen being vented from the cells. Hydrocaps offer solutions to both these problems.

Hydrocaps

A Hydrocap is a catalytic gas recombiner than converts hydrogen and oxygen gasses into pure water. A catalyst is a substance which encourages other substances into chemical change without actually participating in that change, sort of a chemical ambassador. The process occurring in the Hydrocap is similar to that occurring in an automotive catalytic converter.

The Hydrocap replaces the regular cell cap. When the cell is gassing, the hydrogen and oxygen gasses are vented into the Hydrocap. Inside the Hydrocap, a catalyst of platinum and other platinum group metals recombine the gasses into pure water. This water is then dripped back into the cell. The Hydrocap recycles the water that the cell gives off as hydrogen and oxygen gasses. This eliminates the danger posed by the hydrogen gas and vastly reduces watering the cells.

When the cell is gassing, some of the recharging energy is not being stored in the cell, but is breaking down water into its constituent elements- hydrogen and oxygen. Some of the energy used in the conversion of water into hydrogen and oxygen is retrieved by the Hydrocap. When the Hydrocap is operating it gets warm. This heat energy is a by product of the catalytic recombination of the hydrogen and oxygen back into water. While this may seem just an interesting aside, we found the Hydrocap's warmth very useful as an indicator of the cell's state of charge.

Testing the Hydrocap

We installed 6 Hydrocaps on two Trojan L-16W batteries (350 Ampere-hours at 12 VDC) in the Plywood Palace on 9 March 1989. These batteries are recharged by a motley assortment of five PV panels (≈200 peak Watts) and our home made Mark VI engine/generator system (12 to 16 VDC from 5 to 100 Amps). See HP2, page 25, for a description of this engine/generator system. I usually add about a pint of distilled water to each cell per month. Each cell (and this battery has six) has an electrolyte capacity of three quarts. We've been cycling this battery about three times a week; this means lots of recharging and its associated water consumption. Basically, this battery was consuming about $8 worth of distilled water a year.

Hydrocaps installed on a L-16 W Trojan Battery.
Photo by Brian Green.

I removed the cell caps, filled the cells with water, and replaced the stock caps with Hydrocaps. I then fired up the Mark VI engine/generator to recharge the battery and check out the Hydrocaps' operation. The battery was already just about full from the PVs' daily input. It only took a few minutes before the battery voltage rose to 14.5 VDC at 17 Amperes input (about a C/20 rate for this battery). The battery was now gassing slightly. I raised the voltage limit on the Mark VI to 14.8 VDC and now I could hear the cells gassing violently. Each of the Hydrocaps was starting to get warm. I continued to recharge the battery for a while and found that for this particular battery the Hydrocaps stayed warm (but not hot) with a voltage limit of 14.6 VDC.

I found this fascinating. For the very first time I had some feedback on how much each cell was actually gassing. The more a cell gassed, the hotter its Hydrocap became. This battery is over 9 years old and has one cell which is slightly weaker than the rest. I've determined this by long term voltage measurement of the individual cells during all sorts of charge/discharge rates. Sure enuff, the Hydrocap on that particular cell was the slowest to warm up.

The heat output of each Hydrocap provides three valuable bits of battery information. One, it allows the user to accurately determine the voltage at which his battery gasses (a good voltage setpoint for regulators). Two, it allows early detection (and correction via equalizing) of a weak cell by its relatively cooler Hydrocap. Three, when all the Hydrocaps reach the same temperature, then all the cells are equalized (at the same state of charge). And accessing this information is low tech, just feel the temperature of the Hydrocaps!

It's now been over two months since the Hydrocaps were installed on our L-16Ws. I checked the water before writing this and all of the cells are still full. I have not added a drop of water to the battery during this test period. Operation without the Hydrocaps would have consumed about 1.5 gallons of distilled water during this interval. I assume that I will have to eventually add some water to the battery, even with the Hydrocaps. From the virtually zero decrease in electrolyte level to date, I think that yearly watering of the cells is possible in well proportioned systems.

Every time we open a battery's cell to add water we risk contamination of that cell. Batteries are chemical machines and depend on the purity of their reactants for longevity. Hydrocaps reduce the frequency of required water addition and thereby lessen the possibility of cell contamination.

The top surfaces of our batteries are staying cleaner. During recharging without Hydrocaps, a fine mist of acid electrolyte is expelled from the cells along with the hydrogen and oxygen gasses. With the Hydrocaps, there is actually a negative pressure within the cap. The gas recombination creates a slight vacuum within the Hydrocap, and the acid mist is washed back down into the cell by the recombined water. Slick. The process keeps the acid electrolyte from reaching the top of the battery's case and corroding everything. Cleaning the tops of our batteries is one of my least favorite chores. My nose always itches when I've got acid on my fingers…

Based on a catalytic reaction, the Hydrocaps last a long time. The manufacturer says, and I quote, "The life expectancy of a Hydrocap is more than 5 years with overcharge rates below 3 Amperes for two hours each day." What this means to those of us using PVs as energy sources in properly proportioned systems, is very long lifetimes. If our power sources aren't grossly overcharging our batteries, then a set of Hydrocaps should last between ten and twenty years.

Sizing Hydrocaps

Since different batteries have different cap sizes and styles, the Hydrocaps must be fitted for a particular battery. The manufacturer aided us, as he does all his customers, in selecting the right size, shape and overcharge rate for our battery system. Fortunately, Hydrocap makes a specific model that will fit most any battery.

Hydrocap Cost

The manufacturer sells Hydrocaps directly to the end user for $5.50 each, delivered, in quantities of six or more. I figure that over the lifetime of a set of Hydrocaps I'll spend at least two times their purchase price on distilled water alone. And this doesn't include my time to refill and cleanup the batteries, or the added safety factor of greatly reduced explosive hydrogen surrounding the batteries during recharging, or the interesting and useful information offered the cap's heat. The Hydrocaps are worth at least what they cost.

Hydrocap Access

Contact Mr. George Peroni at Hydrocap Corp., 975 N.W. 95 Street, Miami, FL 33150 • telephone: 305-696-2504. George not only sized our Hydrocaps, but was very helpful in providing technical information about his product.

Conclusion

Hydrocaps are a must for lead-acid battery users. They increase the safety of the battery area by reducing explosive hydrogen gas. They are cost-effective by their savings in distilled water alone. They reduce battery maintenance while increasing battery longevity and reliability. They also offer direct tactile feedback regarding the state of charge of the battery's individual cells. We're now running Hydrocaps on all our cells and are specifying them on all the batteries that Electron Connection Ltd. installs. Hydrocaps should be considered necessary, basic equipment for any system using lead-acid batteries. *RP*

Things that Work!

Home Power tests the Thomson & Howe Ampere-hour Meter

Ever wonder exactly how much electricity your PVs or windmachine produced on a partly cloudy or gusty day? Ever wonder how much electricity your refrigerator or inverter consumed? Without an Ampere-hour meter it is very difficult to measure the current production or consumption of intermittent sources or loads. This Ampere-hour meter accurately measures and totalizes the flow of DC electrical current. It works and it can answer many questions about system performance.

Of Amps and Hours

The Ampere is the unit of the rate of electrical current flow. An Ampere is some fantastically large number ($\approx 10^{18}$) of electrons moving past a point in space per second of time. An Ampere-hour is the measurement of the actual number of electrons produced, stored or consumed in a one hour interval. If a load consumes one Ampere for one hour, then it has consumed one Ampere-hour. If the same load operates for two hours, then it consumes two Ampere-hours. Consider a power source that produces 4 Amperes. If it produces for 12 hours, then it has produced 48 Ampere-hours (4 Amperes times 12 hours = 48 Ampere-hours).

Ampere-hours are most meaningful to those of us making our own electricity. Consider a battery for example. Its electrical capacity is rated in Ampere-hours. This is a measure of the number of electrons available from a fully charged battery. The electrical consumption of appliances can be measured in Ampere-hours. Consider appliances which consume electricity at changing rates like refrigerators and freezers. Consider power sources that produce energy at varying rates, like PVs and windmachines. The flow of electrical current, in all these cases, can be measured and summed by an Ampere-hour meter.

An Ampere-hour meter is a cumulative electron counter. It can accurately measure the number of Ampere-hours produced, converted or consumed by a device. The Ampere-hour meter is useful in monitoring the electrical flow through many system components. We chose our PV array for measurement during this 90 day test.

How the Ampere-hour Meter Works

The Thomson & Howe meter uses a shunt to measure current flow. The voltage loss across this shunt is run through a voltage to frequency converter. The output of this converter is totalized on an electromechanical counter. A variety of shunts (50 mV. precision types) are available for this meter, from 1 to 300 Amperes, all with 0.25% accuracy. We used the 15 Ampere shunt to measure the output of our PV array. All shunts are capable of handling twice their current rating. The shunt is externally mounted and can be easily changed to suit the measurement task at hand. The shunt can also be mounted remote from the meter.

The meter is powered by the system under measurement and doesn't require its own battery. It will operate on any DC voltage from 12 to 48 Volts. Since the display is electromechanical, the meter has very low power consumption. The electromechanical display is nonvolatile and will not lose its reading should the meter be disconnect from its power source.

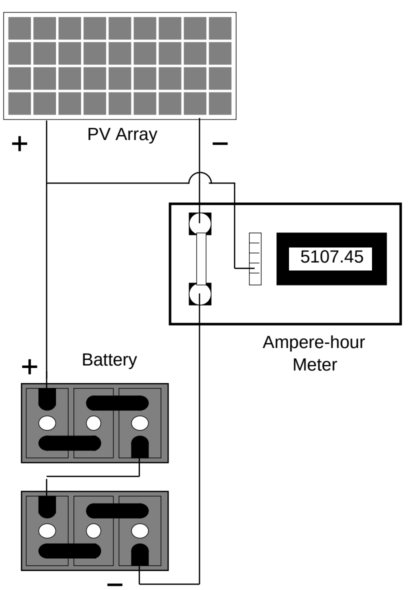
The Test System

We installed the Thomson & Howe Ampere-hour Meter in series with our PV array. This array is an assortment of PV modules we have purchased over the years. It is made up of one Sensor Tech 8 W., one Kyocera 59W., and three Kyocera 48W modules. On a good sunny day our array will produce over 15 peak Amperes.

The Thomson & Howe Ampere-hour Meter.
Photo by Brian Green.

Installation of the meter was fairly simple with only three wires to connect as shown in the schematic to right.

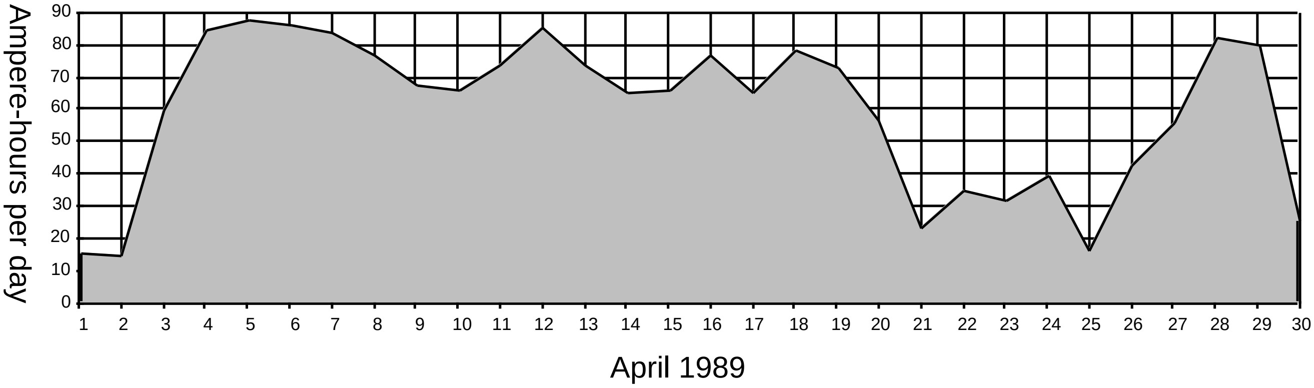
We noted the numerical reading on the counter and recorded this data with the date. The next day, after sundown, we again noted the reading on the counter. By subtracting the previous day's reading from the current reading and multiplying this figure by the current rating of the shunt, we had an accurate measurement of the number of Ampere-hours the array produced that day. We continued to take the data offered by the meter for a 90 day period. As an example of the information we got from this meter, look at the graph above. This graph details our PV array production during the month of April 1989.



Thomson & Howe Ampere-hour Meter Performance

We tested the meter and found it to be within the 1% accuracy claimed by the

PV Array Production as measured by the Thomson & Howe Ampere-hour Meter



manufacturer. Operation was automatic, reliable and fairly silent, the only sound being the soft click of the counter as it operated once a minute.

The documentation supplied with the meter is adequate. It offers all info necessary for wiring it into your system, meter adjustment and for remote mounting the shunt if desired. The physical construction of the meter is rugged and it should last a long while.

The Cost & Access

At $208 ($250 Canadian) this meter is a bargain costing much less than comparable products. The meter has a one year warranty. The exclusive distributor for these Thomson & Howe Ampere-hour meters is Bob Mathews at Appropriate Energy Systems, R.R. 1, Site 9, Comp. 16, Chase, British Columbia V0E 1M0, Canada or telephone (604) 679-8350. Bob was very helpful with telephone support and installation instructions regarding this meter.

Conclusion

Ampere-hour metering is essential for the accurate monitoring of intermittent power producers and consumers. The Ampere-hour meter can perform a wide variety to measurement tasks– from monitoring power producers to actual measurement of varying electrical consumption. Technically minded system users will appreciate this information and can use it to fine tune their systems. Dealers and system specifiers will find this instrument invaluable in evaluating system components.

The Thomson & Howe meter is accurate, efficient and low in cost. We're using ours daily and find that we've been under estimating the long term power production of our PV array. I can't wait to hook it up to the inverter and find out our actual consumption.

RP

Things that Work!

HP tests Backwoods Solar's PV Rack

The Rack

This rack is made of 1/8 inch thick aluminum angle stock. The rack rails are 60 inches long and accept either 3 @ Kyocera or 4 @ ARCO PV panels. The rack is supplied with stainless steel hardware. The rack's feet swivel to mount on roofs, walls and decks. The user supplies the hardware to attach the feet to the mounting surface. There are three adjustment positions predrilled on the rack. The user can easily drill more holes as needed.

Mounting the Rack

I assembled the rack on the ground, using the hardware supplied. The assembly instructions are OK, but really not needed. Rack assembly is obvious. It was lightweight enough that I could carry it up the ladder to the roof with 2 modules mounted. Since my trailer already faces south, it was no problem to face the rack dead south. I spread the legs and bolted down the feet. I used 3/8" lag bolts (2.5 inches long) & washers, all generously buttered with silicone sealer, to bolt the rack to the trailer roof. Assembly and mounting took less than a half hour.

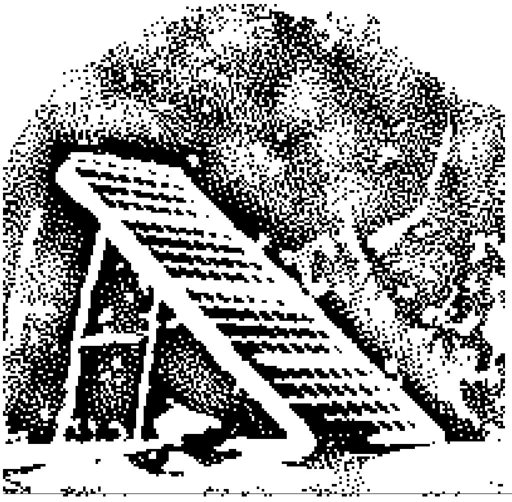
Rack Performance

I've had the rack up for six months now, through what the old timers tell me was a brutal winter. It was below 10°F. for six weeks running with high (30 to 70 MPH) winds. The racks still there. So are all my expensive PVs. At one point last winter there was three feet of snow in the yard. The 45° angle of the rack shed the snow on buildups around 1.5 feet.

Rack Cost & Conclusion

The predrilled rack costs $82 delivered. Backwoods Solar offers a drill-your-own rack for $72 delivered. Considering my rack holds over a thousand bucks worth of PVs, less than a hundred bucks seems like cheap insurance. It works.

Contact Backwoods Solar Electric Systems, 8530 Rapid Lightning Rd., Sandpoint, ID 83864 or call 208-263-4290. JP



the Wizard Speaks…

Cold Fusion

In HP#3 I mentioned the possibility of cold fusion processes. In late March of this year Dr. Stanley Pons and Dr. Martin Fleischmann of the University of Utah announced they had achieved cold fusion in an experiment that produced more energy than it consumed. This experiment was funded by the researchers themselves.

The experiment consisted of a palladium and a platinum electrode immersed in a solution of heavy water and lithium hydroxide. Heavy water is a compound, deuterium oxide, in which the hydrogen atoms have two neutrons. The hydrogen atoms of normal water have one neutron. The lithium hydroxide was there for better ion transfer. A DC electric potential was applied to the electrodes and after a certain amount of time energy in the form of heat was seen to come from the experimental vessel.

It is theorized that the electric potential caused the deuterium atoms to migrate into the crystal structure of the palladium electrode. When the density of the deuterium within the palladium reaches a certain value then fusion occurs. At this density, a type of quantum tunneling effect must occur to overcome the electric repulsion between atomic nuclei and allow the strong nuclear force to be asserted.

Speculation is that it will take at least ten years to harness this process. If it works, we could have cheap, clean energy for the foreseeable future.

HAPPENINGS

PHOTOCOMM, Independent Power Division, celebrates the Grand Opening of its offices, showroom and training center. The celebration will take place on June 9th and 10th at 9:30, Idaho Maryland Rd. in Grass Valley, CA.

The ribbon cutting ceremony will be held on June 9th, during the noon hour. Solar refreshments will be served, entertainment will be provided and active solar displays will be in place. On Saturday June 10th starting at noon, workshops on Solar Technology and Installation for Home, Water Pumping and RV's will be held. These workshops will be free to the public. Also to highlight the Grand Opening, discounts on solar products will be offered to all that attend.

For more information, please call: Ron Kenedi/Sam Vanderhoof, Photocomm, Inc., 930 Idaho Maryland Rd., Grass Valley, CA 95945. (800) 544-6466 • (916) 477-5121.

SUNAMP POWER CO. will hold 2, two day PV Seminars this summer, designed for everyone from professionals to do-it-yourselfers. Some of the topics will be: Introduction to PV hardware, demonstrations of systems, instrumentation, information access, system design, and marketing.

Dates : July 14 & 15, Sept. 15 & 16. Cost of the seminars is $145 which includes two lunches, refreshments, syllabus & classroom materials. For more info contact Ursula Garrett, SunAmp, POB 6346, Scottsdale, AZ 85261, (602) 951-0699.

AMERICAN SOLAR ENERGY SOCIETY, INC.

June19-23, 1989, Denver, Colorado, SOLAR 89 - THE NATIONAL SOLAR ENERGY CONFERENCE, featuring the ASES Annual Conference and the 14th National Passive Solar Conference. For information contact the American Solar Energy Society, 2400 Central Ave., B-1, Boulder, CO 80301, 303-443-3130. The theme will be Clean Energy for a Cleaner Environment, topics will include global warming, acid rain, waste disposal and air pollution.

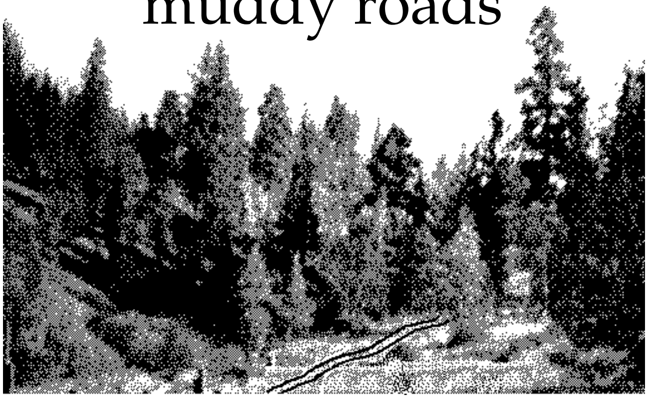
FLORIDA SOLAR ENERGY CENTER

Photovoltaic System Design Workshops, September 19-21 and December 5-7 1989, Florida Solar Energy Center, 300 State Rd. 401, Cape Canaveral, FL 32920, 407/783-0300. Cost: $150 for Florida residents, $300 for out-of-state residents. Contact JoAnn Stirling for more information.

FLOWLIGHT SOLAR POWER

will offer another in a series of PV Water Pumping Seminars in mid July. These seminars are designed for dealers, installers and users. All aspects covered in a hands-on fashion. Contact Windy for exact dates at Flowlight, POB 548, Santa Cruz, NM 87567. or call: 505-753-9699.

muddy roads



Karen Perez

In late March of '74, we had a late spring triple whammy blizzard. The blizzard came on suddenly. A few friends were over for a visit. It was late evening and we were lounging around feeling cozy, very glad to be close to the woodstove. Suddenly it was as bright, inside and out, as a sunny day and the house shook, hard. Simultaneously we whispered, "Oh, No they've nuked Klamath Falls", which had an air base at the time. We sat, hearts pounding, waiting for the end. Well of course nothing happened. We finally calmed down and went to sleep, dreaming of nuclear disaster. Turns out that heavy wet snow had broken the 60kv powerlines two miles away. Never had trusted those durn things. Besides they messed up the view of Mt. Shasta and produced no electricity we could use.

The next morning the blizzard had calmed down, leaving two feet of new wet snow. Being young and foolish we decided to walk out the four miles to the gravel road with our neighbors. Actually, Richard walked and I rode my horse, Bluster Belly.

Our neighbors were on their way to town and Richard decided to go along. I headed for another friends house for more visiting. That's when the second whammy hit. The town crew made it almost to the paved highway (still 23 miles to town) when the front wheel of their car fell off. They all trudged the seven miles back to our neighbor's house. Disgusted, Richard continued on the four more miles to home.

Meanwhile, I was having such a good ol' time visiting that I decided to spend the night at my friend's house. The next morning the blizzard was raging again. I figured it was time to go, no way could I get lost, I knew that road like the back of my hand. WRONG! The first two miles weren't bad, I could just make out the outline of the road. Then the wind started to blow, it was snowing so hard I couldn't see anything. I was lost in my own back yard.

Thank goodness horses are sometimes smarter than people because by this time I was very cold and being real stupid. My friend Bluster Belly knew the way home and was finally able to relay the message to my half frozen brain.

When Bluster Belly got us home, I was a popsicle. We both had a two inch snow buildup on the windward side. Richard pried me off of Bluster Belly and plopped me in front of the woodstove (fussing the whole time). Richard took care of my savior while I started to defrost.

That was our first triple whammy blizzard here in the mountains, but it certainly wasn't our last.

Karen and Our Hero, Bluster Belly.

CQ HOME POWER HAMS

KE5HV • KG6MM • N6HWY

Regional Home Power Nets

(local times indicate local nets)

7.230 MHz on Sundays at 1330 Pacific, Central & Eastern.

3.900 MHz on Wednesday at 2000 Pacific & Eastern time.

14.290 MHz Sunday at 1900 UTC.

Novices

7.110 MHz on Wednesdays and Saturdays at 0500 UTC.

Letters to Home Power

we print 'em unedited.

DC Fluorescent Life

This is to correct data reported in my article "Efficient Lighting for the Independent Powered Home" in HP #9. The comparison chart shows "Lamp Lifetime" data based of fluorescent tubes used on conventional ac power. Long-term tests made at Sandia National Laboratories show that tubes used with DC ballasts have only 40-50% of normal life expectancies. A DC ballast is a sort of miniature inverter that feeds the tube ac power, but at a much higher frequency than the usual 60 cycles per second. This shortens the life of the tube (although it also eliminates perceptible flicker that bothers many people). We wish to be technically correct, not to discourage use of DC fluorescents! The tubes are the least expensive part of a DC fluorescent fixture and still have life expectancies exceeding 4000 hours.

Windy Dankoff, Flowlight Solar Power

Active Solar Thermal Systems

In response to the "Saving Energy Saves Money" article in Home Power #10 I would like to come to the defense of active solar systems. Passive systems are not the only means to consider for domestic hot water heating. The primary concern with any solar thermal DHW or space heating system is that of freezing. Of course geographical location is the determining factor in freezing. While there are many quality passive systems being manufactured there are many instances where a passive system would not be best suited. For example, a combination DHW, space heating, and spa heating. Typically solar contractors have a preferred system, that has proven itself reliable, for their part of the country for a given application. This system may be passive or active.

In the 14 years Heliotrope General has been in business manufacturing solar differential temperature thermostats we have produced easily over 100,000 controls. Many original controls are still operating and we continue to see new systems being installed. Our current controls are backed by a 10 year warranty and we have a documented failure rate of only 1 in 1500 controls.

There are many design considerations for solar hot water heating and active systems have proven themselves to be very viable and certainly workable method of solar thermal hot water heating. If any Home Power readers have questions regarding solar heating I will gladly be of assistance. You may write me at 3733 Kenora Drive, Spring Valley, CA 92077 or call (800) 552-8838 in CA or (800) 854-2674 outside CA.

Sincerely, Mark Albert, Heliotrope General

Flowers

Seems Great. Advertising appearing in HP would seem to benefit everyone... provides sources not available elsewhere. Nitty-gritty writing gets my vote, hands on experience shared with others are a big plus. Keep up the good work.

Joseph Petrarca, Marshfield, VT

Thanks, Joseph. The appreciation of our readers keeps us going. We try to provide needed information that can be easily used. Neither Karen nor I have ever published a magazine before. Home Power has developed a life of its own and led us places we never knew existed. Sometimes when we're real tired, or things aren't going well, we read through the incoming mail. It's the love and energy in your letters that make HP happen. RP

Students Cook with Solar

Dear Home Power, I teach in a private school for students with learning difficulties. I was asked to construct solar cookers in my art classes as part of a science project. The idea of putting together solar cookers seemed like a great way to expand design and construction skills.

I wanted my students to have a basic background or history of the solar cooker. It was also important to make a connection with its practical uses. I remembered reading an issue of HP (7) which featured solar cookers. What I found was clear, brief and in a language my class could understand. The photos provided a stepping off point from the basic design we would be using.

I felt it was important to let you folks at HP know that not only are your magazine articles great for answering energy questions but have also helped a few students understand there are alternatives for their future. As a person who values the future of our planet. I thank you for helping to raise the collective consciousness.

Donna Lanen, Princeton Junction, NJ

Butane Powered Iron Works!

Just wanted to pass on the good word on a wonderful product for alternative living. I purchased the butane iron that Real Goods had advertised in #8 issue. It is so far and away better than 12VDC travel/retrofit "waste of money" and "1000 watt sucker" which required a noisy generator I had before. This gas iron is quiet and HEATS up quickly. It is also easy to turn off and back on again, and I believe I am using less energy because I tended to let the generator run rather than cycle the energy hog up and down. A great bonus is its cordless-ness. Freedom of movement as well as being light weight too. The only difficulties I had in using it was learning to be "firm" when filling it from the canisters, and when it wouldn't fire-up once. The Real Goods people helped me locate the c-clip that had worked free in shipping and got the iron back in working order without my having to return it. They are great to do business with too.

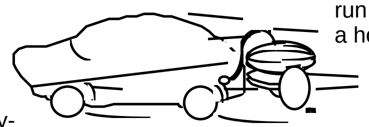
I have passed on to Real Goods the source of my 12VDC washing machine and I hope they will be able to offer it in their catalog soon. I have been using mine for over 4 years and it's as good an alternative as the gas iron. It's also a big water saver.

Thanks Home Power for the reference to Real Goods and thanks Real Goods for supplying me something REAL GOOD!

Katcha Sanderson, Paicines, CA

Watermelon Power!

Your magazine came to my attention at Arizona State University Solar Library. I am a watermelon geneticist and here in southern Florida there is an abundance of highly fermentable vegetable matter (thousands of acres of culled tomatoes etc.) available for energy production. For several years I have been interested in solar distillation of watermelons, since (in Texas particularly) thousands of acres are plowed up each year due to low price for melons. This is a cheap crop to grow, producing many tons per acre and a crushed melon is 95% juice @ 10-12% sugar. Fuel alcohol would be welcome on melon farms to run irrigation pumps. Also I am building a house intended to be solar cooled and powered. Wind is probably out due to hurricanes and building restrictions. Also water purification as swamp water has lots of Fe and H_2S.



You will be hearing from people in this area. Thanks for the magazine.Nichols Eigsti, 10290 Greenway Rd., Naples, FL 33961

Hydrogen Detection in Battery Areas

Preliminary info on a HYDROGEN GAS DETECTOR for alternate energy battery systems, Chestec, Inc. POB 10362, Santa Ana, CA 92711, 1-714-730-9405, speak to Al.

Charging batteries in a home power environment often involves a battery room that is WITHIN THE HOUSE (usually the basement). This tends to minimize radical temperature swings, which are not healthy for battery maintenance. However, there is the danger of hydrogen (and oxygen) gas buildup during the charging procedure. In a well-ventilated outdoor installation this presents minimal hazard; indoors, a random spark (eg, from static electricity) can cause a catastrophic explosion. If on top of that, the home is a vapor-barrier enclosed, super-insulated structure, the danger is compounded. Thus, I've been looking for a way to detect the gases, so that a exhaust fan can be triggered in a timely fashion.

It appears, after years of searching, I've found a unit that doesn't cost more than the battery system itself. It's made by Chestec and is their model #CBHRB-12v. It will apparently work for 24 volts also. It goes for about $50 plus shipping. Make sure to ask for the model with a relay output (in addition to the standard sounder output), so that you can remote it or turn on a fan, etc.

A problem for alternate energy user is that it requires the use of a small heating element; that brings the current drain up to 130 mils standby (and 150 on alarm). I plan to get around that one by providing it with a PULSED power source, so that it checks things out maybe every 6 hours or so; each time it's turned on it must stay on for about 2 minutes, in order for the heater to reach steady-state and do a valid check. A timer based on a multiple 555/CMOS version should do the trick. And/or the duty cycle of the detector could be tied to the photovoltaic charge controller so that it is turned on only during that part of the charging process that will cause gassing. I'll report on how the unit works out and what timing circuits are needed with it.

William Schenker MD, Zillah, WA

Efficient 12 VDC Light Dimmer

First I want to express my deep appreciation for the noble work represented by Home Power. Not only are you learning to live in harmony with the Earth, you labor long and hard to pass your education on to your fellow men. I am sure I am only one among many who extend to you and your crew our true admiration.

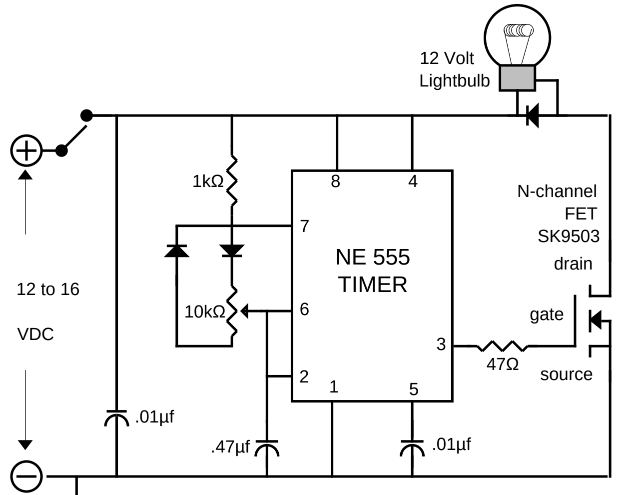
Enclosed is the spec sheet on the 12 volt dimmer I designed for reading lamps aboard my 63' ferro-cement ketch, Bandersnatch. The basic lamp is a very nice oak swivel bullet lamp sold by JC Whitney for RV use. They come in solid oak and other woods, in various configurations and appear to be made in California. If I remember right, they sell for about $13, but I don't have the catalog with me.

I removed the pushbutton that comes on them and replaced it with the dimmer. The Radio Shack pot is a little too deep to fit into the base of the lamp without using a Forstner bit to deepen the recess. The Philmore pot is much smaller and fits without modifying the lamp.

The NE555 timer produces a square wave output turning the FET on and off. The pot varies the "on" time of the FET by varying the "on" pulse width of the square wave. This varies the average current through the bulb and thus the power. Since the FET is either completely off or completely on there is little friction to the electricity to cause heat and therefore the FET runs cool and wastes very little of our precious electricity. The life of electronic equipment is also directly related to its operating temperature, as I am sure you are aware of. The dimmer works nicely but I have not had it long enough to give it a "real life test", nor have I used it for anything but the little bullet lamps. I think it would work well for motors too (fans, etc.), but have not tried it out on them yet.

I know you use Macs but can you support editorial submissions on IBM 5" format too? Sure would make life easier for SOMEONE at Home Power. I have a Sanyo MBC-775 transportable I bought on sale from C.O.M.B. for $900 that I like very much. It has a standard footprint but a low profile, 2 360K drives, an 8" color CRT and only uses 80 watts according to specs. Unfortunately it requires voltages above 12VDC so I will have to run it with an inverter. I have a Panasonic KX-1080i printer I am very satisfied with. My personal correspondents have all applauded my switch from handwriting to word processing (PC-Write). Using different colored ribbons, varying the fonts as I write and always using NLQ or better (ImagePrint) softens the harshness of plain vanilla output. However, I still use pen and ink for my most intimate communications even though I compose it first on the word processor.

I am working toward self-sufficiency aboard Bandersnatch and will keep you posted on any significant developments that others may be able to take advantage of.



A fellow traveler, Norman, S/V Bandersnatch, Green Cove Springs, FL

P.S. I was in a waterfront dive one night a few weeks ago and received a lesson in assumptions. While watching the lizards stalk various unidentified prey along the overhead I was astonished by a light fixture. There were several incandescent fixtures and one fluorescent fixture, the whole group controlled by one dimmer. Lo and behold the fluorescent bulbs were dimmed right along with the incandescents, and quite effectively too. So much for my "conventional wisdom". (Doesn't it say on every 120vac dimmer package "For incandescent lamps only!"?) I just ASSUMED they knew what they were talking about. Maybe you could find out more about this development.

Get the Power Co. to go PV?

I would be interested to hear from Home Power readers about the idea of getting state utility regulation boards to force utilities to subsidize and finance auxiliary PV systems by allowing purchasers to pay them off through their electric bills.

The Philadelphia Electric Company is owner of one of the last nuclear power plants in the nation under construction. They say they need it because of peak summer power demand. But I suspect that a few thousand PV systems all over the city would take the edge off that demand quite nicely. We must remind the power companies that they are state-sanctioned monopolies serving at OUR pleasure -- even if they seldom act like it.

Does this concept sound familiar to HP readers in other states? Are similar notions making progress anywhere? Please print my address: Noel Weyrich, Box 42044, Philadelphia, PA 19101. Thanks!

Motion Sensing Control

A recently developed electronic gadget to appear on the market is a motion sensor light control. Called a passive infrared detector by burglar alarm people, Taiwanese manufacturing has now brought the price down to around $20 for homeowner installation. Basically it detects movement of heat-emitting bodies by means of a special lens and infrared electronics. They come with floodlight sockets for security lighting, but can be used to turn on other devices. Some models can be connected to operate on 12VDC such as the Heath-Zenith SL 5410A. The similar 5310 does NOT - it seems to need both 9V and 24VDC. I would guess similar units WITH internal transformer (such as 5410A) are likely to be 12V. The transformerless models are very lightweight, you can tell by heft. If you'd rather not try converting, Real Goods sells a 12V model for $68.

You could also wire one up for an indoor light - enter a room, the lights come on, leave and they go off automatically. One thing, large dogs will trip the lights the same as a human, cats are detected but only at close range.

Here's one way to convert the Heath-Zenith SL 5410A to 12V operation: Open the cabinet by removing 4 long sheet metal Phillips-head screws in the corners. They are tight, keep a firm steady pressure to avoid stripping the heads. Carefully separate the halves. Note there is a molded rubber gasket - make sure this stays in its groove. The detector half plugs into the power supply half via a 3-pin plug. Set the detector half aside where the pins won't get bent. Lift off the rectangular cover and remove the power supply board via 2 Phillips screw.

With a soldering iron and solder-sucker, desolder the 2 primary and 2 secondary pins on the transformer, also the mounting tabs. If you don't have experience soldering the new thin copper Taiwan circuit boards, have an experienced technician do it. They are VERY easy to ruin. By removing the transformer, you separate the relay contacts from the power supply (so you could switch a different voltage or circuit). The Red and Black wires are now a Normally Open switch circuit which is already internally fused for 4 amps. Connect 2 wires to the holes where the 12V secondary went (The side with most of the electronic parts. They lead to a small black circular device with 4 pins.) The White wire is not used and can be cut off. The 2 wires you added are now your 12VDC supply to the detector. They are on the ac side of a bridge rectifier (the black thing) so EITHER polarity will work without damage. Be aware the electrolytics are 16VDC rated, so this unit should be on a circuit that is disconnected when you are equalizing your battery.

I've run it from 11.8V to 15V with no problem or change in sensitivity. The idle current is a minuscule 5 milliamp. This increases to 65 ma (plus whatever you have it turn on) when the relay energizes.

Follow the set-up instructions with your unit. The 5410A can see a person walking 50 to 70 feet away in a pie-shaped arc of 100°. It seems to be impossible to sneak up on it.

S. Marshall, Dover-Foxcraft, ME

Keep PVs Decentralized!

Wouldn't you know it? I've read every issue of Home Power, one through ten -- cover to cover, including ads -- but what motivates me to write, finally is a gripe. In "Photovoltaics - The Alternative to Life in a Greenhouse", Gary Starr wrote that "a piece of desert land about 2 miles square could host a solar generating plant with the power production capacities of a large nuclear or coal plant."

The greatest beauty of solar power is its availability at (or very close to) the point of use. The sun shines almost everywhere that power is needed; why pay a utility to ship you some sunshine from hundreds of mile away over unsightly and environmentally damaging powerlines? Four square miles of PV's is obviously better than a large coal or (especially) nuclear plant, but it is an absurdity compared to dispersed PV's at points of use. Let's not do anything to encourage centralized power generation of any sort. It is true that PV's can beat fossil fuel and nuclear plants at their own game, but so what? It's a game we shouldn't be playing.

I designed my retirement home (which I'm still working on) to be passive solar and it works even better than I imagined. The county required me to get a propane wall furnace, not accepting a woodstove as an adequate back-up to solar, but I haven't installed the furnace yet and used the stove more for cheer than warmth. An aspect of passive solar that I haven't seen much reference to is heat gain from the earth under the slab. Without any auxiliary heat, it kept the air temperature at 45° when it was minus 10 outside in February. Since the house shell was finished and insulated, it has never gotten below 50° inside except when it was sub-zero outside. If I had put insulation between the earth and slab, presumably the slab would have warmed faster and cooled faster, with greater daily temperature swings. But I think it makes better sense to recruit the entire earth to "try to keep my house no colder than 50-something in winter and no better than 50-something in summer.

Photovoltaics are fascinating, but let's not overlook the benefits of direct solar heat gain.

So much for opinionated opinion. Now for a question.

When I can save enough from Social Security payments and part time work, I plan to have a modest electrical system with batteries, inverter and PV panels. (I wired the house conventionally before I was aware of the 12 volt option.) My "need" for electricity is urgent only because of music. I have a fine hi-fi system, but have had to rely on a portable radio powered by three AA nicads, which I recharge with solar chargers. The best that can be said is that the sound is reminiscent of music.

My question is, can I enjoy my hi-fi equipment before my ultimate solar electric system is in place? Would it be practical, for example, to get batteries and inverter ahead of the rest and recharge the batteries with the 4 KW generator I already have? This would depend, I suppose, on how often the battery(ies?) would need to be recharged with only the hi-fi system as a load. I probably average six or more hours a day listening to KSOR (the local PBS station). Frequent recharging would pose problems. My "portable" generator isn't very and I use it mostly at the wellhead nearly 300 feet from the house. But if batteries would only need recharging every week or so, I wouldn't mind the inconvenience. I would also need to consider how long the generator would have to run to recharge the batteries. It is used almost entirely, up to now, to pump water from a 400 foot well. To repair or replace the generator is an expense I can ill afford, so I must minimize its use.

Thanks for the enlightenment and encouragement you freely provide. It's a service you're entitled to take great pride in.

Hugh Nash, 7021 Quarry Rd., Weed, CA 96094

Q&A

We try our best to answer all your questions. Please remember that we are limited by our own experiences. If we don't have the direct personal experience to answer your question, we won't. We'll print the question anyway and hope that a Home Power Reader will have the experience to answer it. So this column is not only for questions , but also for answers from readers. Thanks for your patience-- Richard

---

Answers from Home Power Readers

Flues and 24 Volt Equipment

In answer to Loren Amelag's question about a coating for his solar flue (HP#10, pg.42).

1) EPDM rubber used for roofs. Some calls to roofers might yield enough left over material to do a small area.

2) Premixed cement used for mortarless concrete block assembly available probably in local lumber yards. These mixes contain special glues and fiberglass filaments so they can be trowled to 1/8th of an inch without cracking.

3) "Insulcrete" made by Dow is a similar material which was specifically designed to be trowled (or gunnite sprayed) over fiberglass laid on top of "Styrofoam". It also contains special glues and fiberglass filaments. Recommended thickness = 1/4 inch.

In answer to Nancy Dooley about locating 24 volt equipment (pg.42, HP10) try Solar Retrofit Consortium (Box 34, 200 E. 71st St., New York City, NY 10021-5138, (212)-517-3580), an advertiser in HP. I spent an hour talking to their head designer about their products, all solar and AE equipment, some of which they manufacturer themselves. He told me that 90% of what they have is not in their catalogue. I'm getting the catalogue anyway. He said they have about 8,000 DC motors in stock, ranging from 12 to 48 volts. They make their own refrig which he claims is about 30% more efficient than SunFrost, largely because it has more insulation. The insulation is shipped separately as it makes the frig too big to go thru standard doors! It comes with a small fan and vent so the heat can be directed outside. Maybe cold can be directed in reverse in the winter? It also has a tray for condensate which can supply distilled water for batteries. Apparently in the first 3 months of this year they sold $1,000,000 worth of equipment, mostly to the Caribbean and Third World countries. They have a contract with Eureka to make a full sized 12 volt vacuum cleaner. Thought you might like to know about these folks in case you didn't already.

Delighted to see your readership growing! Due to the quality of your mag, I hope you will become a truly major national asset to all of us who want to go with AE systems. I am particularly impressed with the space given to reader responses. In a field as new as this, the quickest way to learn is from the successes and failures of others.

Cordially, Donner Denckla, Washington, DC

Wood Burning Hot Water Heaters

Dear Home Power Crew: Keep up the good work as it is GREATLY appreciated by all of us.

Patricia Ganyard inquired about a wood burning water heater in the Q & A section of HP10. That jogged my memory a bit to look this one up in the Cumberland General Store catalogue. Their address is Rt3, Crossville, TN 38555.

Thanks A lot, Barry R. Smith, Olean, NY

Thanks Barry. The heater that Barry is talking about is a Magamex Model R-3. The Cumberland Catalog says that this heater is designed for a maximum water pressure of 200 psi, is compatible with existing plumbing, requires only the installation of a stovepipe and standard U.S. 125 psi temperature and pressure relief valve. The Magamex has a 14 gallon capacity but is designed to heat up quickly and then provides a continuous flow of hot water as long as the fire is maintained (three or four chunks of wood the size of 12 inch 2x4's every half hour, during periods of high demand, provide all the hot water you'd need). The promo also says that you can use junk mail and shredded cardboard for fuel.

The dimensions are 11.41" diameter, height 57.08", weight 50.05 lbs. Stovepipe size 4", firebox 11"x22 1/2" Shipping weight 60lbs. Shipped FOB Price $306.25 (Don't know how old the catalog is though). KP

More on Wood Fired Hot Water Heaters

Someone wanted to know about wood fired hot water heaters. The "AguaHeater" is available from Domestic Water Works, POB 809, Cave Junction, OR 97523, (503) 592-3615. No price is listed in the catalog so you have to call, probably the price changes a lot. So there you are. Hope this helps someone.

D.S.,Hayfork, CA

More on Palomas

Dear HP

Besides being a successful soccer coach and father, etc. my one claim to fame is my service experience with Paloma water heaters. Regarding Tim Traquair's problem:

The spec. on the PH6DP Paloma says: Min. water pressure 4.3 psi. Firstly, that number only applies when the heater is turned completely to the "hot" setting. What that number means is that the incoming water pressure must exceed the resistance thru the plumbing system by at least 4.3 psi for the heater to fire on the "hot" setting.

Each elbow, valve and vertical run downstream from the heater has a resistance measured in psi. If you were to calculate total resistance to the outlet of the showerhead (which incidentally can be as high as 10 psi) then you add the 4.3 psi and you know how much pressure you need on the incoming.

Gravity feed is certainly a problem for all tankless water heaters. The heater with the lowest pressure requirement among all tankless water heater brands is the Paloma PH12M and the Paloma PH16M. Both require 2.1 psi more than the resistance on the outlet side to make them fire on their "hot" setting.

The reason for your problem is product safety. I would not suggest an tampering with the Paloma. What I would suggest is putting a 12V pump on a toggle switch and when you want hot water flip the switch and open the spigot.

Neil Green, Low Energy Systems, 2916 S Fox St, Englewood, CO 80110, (303) 781-9437

More on Palomas and Sterling Engines Question

In response to Timothy Traquair's problem (Q & A HP9) with Paloma propane water heaters not coming on because of low water pressure from his elevated water tank. I had the same problem. I also have an elevated water tank. Most times the heater would not come on, on demand, because the water pressure was too low. I over came the problem by ordering a Flojet 12VDC pump from Real Goods in Ukiah, CA. I installed it between the tank and the water heater. This pump has a built in pressure switch which turns the pump on and off automatically. After installing the pump, the problem was solved, the heater came on whenever I opened the valve and then the pump came on and kept the pressure up.

Also in HP9's Q & A I read where Linda Roger's is planning on wiring a sterling engine to supply electricity. I wish to get more information about the sterling engine. I did not know they made sterling engines that are of any use other than experiments and demonstration.

Isaac Amstutz, Dublin, MS

For more information on sterling engines contact Stirling Technology Inc., 9 Factory St., Athens, OH 45701, (614) 594-2277. These folks make a homestyle 5 HP. sterling engines capable of producing 3.5kw, ac or DC. KP

A Bunch of Answers to Questions from HP9

Hopefully I can provide answers to several questions some of your Home Power readers have posed in issue #9. First DC washers: In many washers the ac controls can be eliminated or bypassed providing an all DC machine, although without the timer, etc. I usually use old machines that have been given to me and so most of the time the timer and/or water level switch is bad anyway.

Sears machines have a motor that turns in one direction, the agitation and spin cycles are shifted by two small solenoids. The motor obviously needs an on/off switch if converted to DC operation. It may be possible to use the solenoids with DC but will probably require replacement with a 12 Volt solenoid winding. At any rate, all that is required to shift this machine is a three position switch which has on-off-on positions. The center position places the machine in neutral, while toggling to one side selects agitate and toggling to the other selects spin dry.

Many machines just reverse the direction of rotation of the motor to shift from agitate to spin. This is even easier to effect once the DC motor is installed. Thus all controls but a forward/ reverse switch can be completely eliminated. I prefer this manual control over the system myself.

On water pumping windmills and using them to produce electricity: This is a marginal idea. The water pumping is optimized for torque (twisting force) NOT power. The truth is that all of those vanes get in their own way. A single blade is the most efficient for developing power. The "secret" here is drag; the force you feel on your hand when you put it out the car window. With a single blade drag is minimized and power (and rotor speed) is maximized. With 16 or 20 blades drag is maximized. In fact drag is so extensive on these multi-blade turbines that the power output of a waterpumper is self limited to 2-3 horsepower because as the turbine gets up to speed drag quickly costs more horsepower than the turbine can produce. So why multi-blades?

All things are a compromise. Although a single blade produces the most horsepower per disk rotor area you don't see many. Although, if I remember correctly, the West Germans were, are, or have built a large one. Most wind turbines are 2 or 3 bladed. This is a comprise for balance and/or rotor strength.

With a water pumper maximum output is not as important as with a wind generator. You want that hummer to start pumping in a gentle breeze and to keep pumping as long and as often as possible. To pump water you need to overcome a lot of inertia (weight of sucker rod, pump, and water being pumped) and friction (of pump, seals and flowing water) to even get the thing moving and you want to do this in practically no wind. Thus high-end performance of a water pumping windmill is compromised to maximize performance at low wind speeds. These units can start pumping in winds as low as 3 mph compared with an absolute minimum of about 9 mph for an electrical wind generator, most need about 12 mph for an effective output.

I am not trying to say "never" to use the use of a water pumper for generation. Compromise is the name of the game. If you have one it may be easier to attach an alternator to it than to spend the $1,500 to $10,000 to do it "right". Just remember that you ARE making a compromise.

On converting the Servel or probably any other gas refrigerator from natural gas to propane/butane (LP gas): Natural gas has much less heat energy per cubic foot than LP gas, thus a natural gas appliance must use about three times the volume of fuel than a propane/butane appliance uses. This means that the metering hole that helps the flow of natural gas must be larger. To convert to LP gas this metering orifice must--somehow--be shrunk.

I have accomplished this several times on Servel gas refrigerators by removing the metering orifice in the burner and VERY CAREFULLY peening around the edges of the hole in the middle with a center punch. This will displace metal toward the orifice closing it slightly. You can use a sharp needle or awl to round the inside of the orifice for smooth gas flow.

I stress that this is NOT the preferred factory method and it helps to understand what you are doing. The correct way is to replace both the orifice and, in the Servel, the turbulator beneath it and to choose the correct orifice based on actual measured gas flow. In some cases even the burner unit will have to be changed. A CAUTION here. When disassembling the burner unit in a Servel DO NOT, under any circumstances, try to remove the "Clixon" safety valve for any reason. This is not designed to be removed, it is not serviced separately from the burner and an attempt to remove it will likely remove all of the threads inside the burner which the "Clixon" is screwed into --98% chance of this--requiring purchase of a whole new burner.

You must keep the inside of the orifice smooth to keep the gas flow smooth. Fuel gas normally flows through the turbulator, which imparts a swirl to the gas, then it flows out through the metering orifice and into the burner mixing chamber. The natural gas turbulator has two grooves in it to accommodate the extra volume of that low caloric gas, while the LP gas turbulator only has one. Ideally the LP gas turbulator should be used to keep gas velocities up but the natural gas part works--of a fashion.

These are worst-case "field modification" instructions. Were possible you will be ahead by having the conversion done by a knowledgeable person who has the correct burners, orifices and turbulators on hand.

Last is inverter hum in electronics: This hum can be minimized in some equipment by the simple steps of using grounded 3-wire outlets and also trying different positions for the 120 vac plugs. For instance, if a turntable is plugged into a switched receptacle on the back of a stereo it can build up a 60hz field on its chassis. Grounding the chassis directly to the third (grounded) prong on an outlet (make sure that it IS grounded) can sometimes reduce the hum markedly. So can simply unplugging it, turning the prongs 180° and plugging it back in. This works because there is a "hot" lead and a grounded lead on most tools and equipment and if you get them reversed it can feed the 60hz signal into the amplifiers. Once you've minimized the hum this way you may not need a noise filter but if you do you will find it much more effective.

GEI (Gas Energy Inc.), 166 Montague St., Brooklyn, NY 11201-9871 makes gas air conditioners, as well as those running on steam and waste heat. Unfortunately they are only useful if you happen to own the Empire State Building as they are designed for industrial complexies.

Solar evaporative coolers are here already. Contact the University of Arizona, Environmental Resources Lab, 2601 E. Airport Dr., Tucson, AZ 85706-6985. Ask about the Oasis Project and cool tower technology as well a solar chimneys.

Clifford W. Mossberg, Fairbanks, AK

Q & A on Ni-Cads

Congratulations on your fine publication! I'm really impressed to see how it is growing. I hope to spark some discussion on a topic I have yet to see discussed between your covers--rejuvenation of "dead" ni-cads. I buy and use a lot of surplus ni-cads of primarily AA and, more recently, the 4 A-h D sizes. Although I am careful to fully cycle my batteries every month or so to avoid the formation of a dysfunctionally short "memory", it is often the case with these surplus batteries, and occasionally with new ones, that they cease to take a charge after a year or so of regular use.

I have recently discovered, through trail and error, that I can use very brief applications of higher voltage current to reactivate these batteries, and it is this I would like information on. When I use my Radio Shack Universal Voltage Adaptor, 7.5 Volts at 300 mA. is enough to get AA's going. At first I left this current on for long periods, but I soon found that it only took five or ten seconds to affect the battery enough so it would then accept regular charging current.

C cells and the big 4 A-h D cells seem to need more than my little adaptor will give. The only resistor I had was a 3 ohm, 3 W. model, so I tried that. It took care of the C cells in two to three seconds, before it had time to heat up. But the big D cells needed more time and the box-like resistor was hot enough to melt zip cord insulation before each of the five of the seven batteries I tried to fix would take a charge. Two of them still read zip on my voltmeter.

So, finally, to the questions: What am I doing to these batteries? Will it last? Assuming this fix is worthwhile to do (and it seems to be for me--I'm using batteries that haven't worked for ages), how do I calculate correct resistor values and "zap" times for various sizes of batteries? Last, but not least, why would ni-cads cease to take a charge after only 300 or so cycles, anyway? Is there a way to avoid this in the first place?

Many thanks for the forum you provide. Hard to image life without Home Power. Rick Goodier, Huntsville, AR

Zapping works! After many cycles, nicads develop "dendrites". Dendrites are whisker thin tendrils of nickel and cadmium that form short circuits between the cell's electrodes. A dendrite is just a few molecules thick. The dendrite can be vaporized by running a substantial amount of current through it in a very short period of time. The trick is to vaporize the dendrite without gassing and ruining the cell. All nicads have vents to protect them from explosion caused by too rapid charging. Some nicads contain resealable vents and some have vents which only operate once.

I've zapped single D sized (4 A-h) cells using the following method. Place the nicad cell's case (it's negative pole) on the negative pole of a large lead-acid battery. I use a single L-16W (6 VDC at 350 A-h). Hook a 14 gauge copper wire to the positive pole of the lead acid battery. Touch this wire to the top of the nicad (its positive pole) for ***just an instant****. There will be arcing and sparking as the big lead-acid battery puts about 10 to 50 Amps. through the small nicad. The nicad will get hot. BE careful when zapping. The cell may explode if you overdo it, so wear goggles and gloves. While I've never had one explode, I have ruined some by venting the cell. If the cell is cooled in snow or in the freezer before zapping, then venting is greatly reduced. Zap the cell only once, then cool it before zapping again. Some cells take several zaps to vaporize all the dendrites. Use a smaller lead-acid battery (or fewer series cells of a large battery) to zap smaller nicads like C and AA. A lead-acid battery works best as a zapping source because it can deliver high amps easily. After zapping, recharge the cell normally. I'm still using cells I recycled over five years ago, so the fix looks permanent.*

Dendrites can be prevented by proper recharging. Use high ampere pulses to recharge the nicad. This vaporizes the dendrites as they form. See HP#5, page 27 for detailed info on recharging nicads using pulses, building a pulse type charger, and zapping.RP

Self Regulating PVs

I know that Kyocera, ARCO (and perhaps other manufacturers) have "Self Regulating Modules". These generally have fewer cells and consequently operate at lower voltages (ie. 14.5VDC) instead of the typical 16 to 17VDC modules Since you are the author of "The Complete Battery Book", I would appreciate your comments as to:

1) What are the most appropriate applications for Self Regulating Modules (SRM's): a) 1 Module for 1 battery (ie. RV, boat) or b) 4 modules for 4 batteries (ie. cabin)?

2) Will an SRM do a good job of fully recharging a conventional lead acid battery (ie. RV, marine deep cycle, golf cart, etc.): a) in mid-winter and b) during hot summer days?

3) Can an SRM "overcharge" and damage a battery? How can I tell if the battery is being overcharged?

4) If a battery can be overcharged by an SRM, and what can I do to prevent this from happening?

5) As a general guideline, under what circumstances is an SRM a good choice?

Joe Solar, Sun City

Well, Joe, you've asked a mouthful… Let's start with question #1. The best use of SRMs is in small (one battery ≈100 A-h and one SRM) intermittently used systems. Larger systems are better off with standard 36 cell modules and a regulator. This is an energy vs. cost decision. Question #2: Yes the SRM will fully recharge a lead-acid battery, they just take much longer to do it, especially when the battery is above 75% SOC. The SRMs also recharge slower as the winter's cold elevates the recharge voltage of cold batteries. All PV modules decrease in output when they get really hot during the summer. The same is true only more so with the SRMs as they have fewer cells to work with. Question #3: Yes, an SRM can overcharge a battery. Over a long period of time, an SRM in an unused system can eventually boil the battery dry. The problem here is not really the SRM's fault, but the user's fault for not doing his maintenance. If a system must be left unattended and unused, then even the SRM must be controlled to prevent boiling the battery dry. Use a blocking diode to drop the incoming voltage by ≈0.5 Volts. Use Hydrocaps to recycle the water lost by the cells. Leave a small load on in the system. Or finally use a regulator. Question #6: The SRM is best applied in small system cycling under 20 Ampere-hours per day. RVs and occasionally used cabins are good places for SRMs. They are not cost effective in larger (>40 A-h/day) systems, or systems with large temperature extremes (average daytime temps >100°F. or <30°F). RP

Stoves

A friend brought by a copy of your magazine. It's great.

What do other people with 12 volt systems do about the 110 requirements of gas stoves. We used to have an old stove. Now we've bought a middle aged one and the oven doesn't work unless the timer is plugged in. Does anyone have alternatives to buying an inverter?

Diane Paget, POB 223, Philo, CA 95466

The problem is an electrically activated valve that controls the gas to the oven on command from the timer. Remove or bypass this valve and you'll have a regular manually controlled gas oven. The thermostat is almost surely thermally operated and requires no electricity. If you're not handy with tools, then get your local appliance techie to help. RP

LED Voltmeter

A friend just sent me #10. I think it's great. I design and install these systems locally. Your articles seemed right on and I like the access to other people, ideas, and manufacturers you provide. I am, today, following up on the permanent magnet motor patent letter (hope I can make something of it!!).

Is there any easy way I can get the LED voltmeter to give me 1/10 volt increments? Can anyone there tell me why I can only get LED's in red, green & yellow? No clear? Blue?

Bill Seckler, SolarWind, POB 780, Bandon, OR 97411

Yes, the LED Voltmeter can be made with 1/10th Volt resolution. Directions for "cascading" several LM3914N chips is in National Semi's application literature. It will take 50 LEDs to cover the range of 11 to 16 VDC with 1/10 Volt resolution. That's complicated, expensive and consumes a fair amount of power. If you want that degree of resolution, use a digital meter. It will be more accurate and cheaper. The color of an LED is determined by the composition and construction of its semiconductor junction. There are only a few compounds that can be made into junctions which will emit light in the visual range. There are blue LEDs, but they are very hard to make and expensive (>$50 each). All LED junctions emit monochromatic light. White light is made up of many colors and no one now makes an LED that produces white light. RP

Access and Passive Solar

Do you have/know of a mail order source for: 1) radiant shield discussed on page 21 of HP10 2) Solar Shade screen material discussed on the same page and issue? Also, what are the range of options for passive solar hot water rather than a black hose hanging in a window or laying on a roof in the summer. Also, do you know of a mail source for tankless hot water heaters discussed on page 22, HP10.

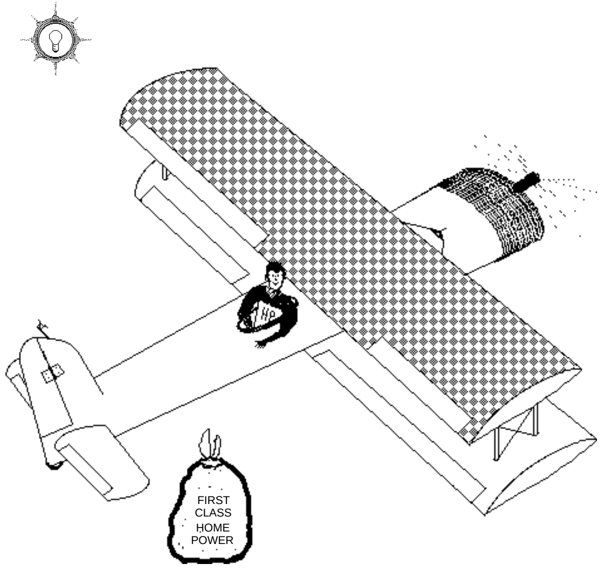
Ronald Bushy, Stigler, OK

Solar Components Corp., 121 Valley St., Manchester, NH 03103 • 603-668-8186 can supply radiant shields and other solar heating/greenhouse products. Tankless hot water heaters are available from Real Goods, see page 2 this issue. RP

In solar hot water systems, PASSIVE just means there's no pump to push the heated water from collector to storage tank. ACTIVE systems work, too. See Mark Albert's letter on page 44. There are two types of passive systems. The most common and simplest is the thermosyphon. Here less dense heated water from the panel (or black hose or whatever…) rises to a tank while cooler water in the tank sinks via a return line to the bottom of the collector. The folks at Sage Advance have developed a passive hot water system in which the tank need not be higher than the panels. See HP#8, pg. 20. We've never tested it. CG

FIRST CLASS HOME POWER– $20

Get Home Power faster and more securely via First Class US Mail,see page 53 for details. Get Home Power FREE via Third Class US Mail, see page 27 for details.



INDEX TO HOME POWER MAGAZINE ISSUES #1 TO #11

INDE

Home Power Index

Home Power's Business

Display Advertising

Full Page	$1,200	67.5 sq. in.
Half Page	$672	33.8 sq. in.
Third Page	$480	22.5 sq. in.
Quarter Page	$377	16.9 sq. in.
Sixth Page	$267	11.3 sq. in.
Eighth Page	$214	8.5 sq. in.

Maximimum Vertical Ad size is 9 inches
Maximum Horizontal Ad size is 7.5 inches

We can set up and lay out your display ad. Camera ready advertising is also accepted. For current, detailed reader demographics, call us.

Long term display advertising is discounted, so buy ahead and save.

Home Power is published bi-monthly. Ad Deadline for the August/September 89 issue (HP#12) is 15 July 89.

Cal l **916-475-3179** for further details.

International Subscriptions

Due to the high cost of international mailing & packaging, we must charge for copies of Home Power that are mailed anywhere that doesn't have a US ZIP CODE.

2 YEAR- 12 ISSUES
INTERNATIONAL RATES:

Mexico or Canada: Air- $24. Surface: $21.
Central America, Bahamas, Bermuda, Columbia and Venezuela: Air- $32. Surface: $ 23.
South America (except Columbia and Venezuela), Europe, North Africa: Air- $40. Surface- $23.
Asia, Australia, New Zealand,Pacific Ocean Islands, Africa (other than North Africa), Indian Ocean Islands, & the Middle East- Air $49. Surface $23.

All payments in US currency ONLY!

Surface shipping may take up to 2 months to get to you. All issues shipped in mailing envelopes to withstand the rigors of international mailing. If you have friends with a US Zip code who regularly send you packages, then we would be glad to ship them an extra free copy for forwarding to you. Bulk mailing to Canada or Mexico, write for info.

Home Power Mercantile

One insertion per customer per issue.
We typeset all ads. We do the best we can to make your ad look good. If you send too much copy, then you're bound to be disappointed. Flat Rate $80. Advance payment only, we don't bill Mercantile Ads. Your canceled check is your receipt.

Back Issues

All back issues are $2 each, while they last. Shipped in an envelope via First Class US mail.

Issues 2, 3, 4, 5, 6, 7, 8, 9, 10 &11 are currently available. Sorry no more Issue #1s are available.

Home Power Magazine
POB 130, Hornbrook, CA 96044

Micro Ads

These ads are designed for individuals rather than companies. So use your discretion. The rates are 5¢ per character, including spaces & punctuation.
$10. minimum per insertion. Send check with your ad.

Printing & Distribution Info for HP#11

Copies Printed = 17,000
Copies mailed under 3rd Class labels = 11,802
Copies shipped in bulk = 1,741
Call or write for bulk shipment info.

First Class Home Power

We offer a years worth of Home Power Magazine (6 issues) via FIRST CLASS US DOMESTIC MAIL for $20. Many of you have asked for faster and more reliable delivery of your issues. So here it is: FIRST CLASS HOME POWER. You will receive your issues faster, and with all the First Class percs of forwarding, secure delivery and address correction. Home Power gets a few bucks for support, and you get secure, fast delivery. If your First Class Subscriptions runs out, you will automatically get your future issues FREE via third class mail. So, get HP fast & help out too!

Home Power MicroAds

Rates: 5¢ per CHARACTER, include spaces & punctuation. $10 minimum per insertion. Please send check with your ad. Your cancelled check is your receipt.

JACOBS WIND ELECTRIC replacement parts, new blades, and blade-actuated governors. We make replacement parts and have new blades for most all wind generators, pre-REA to present models. Many used parts, too. Lots of used equipment available: wind generators, towers, both synchronous and stand alone inverters, and Aermotor waterpumpers. Best prices on TRACE inverters and SOVONICS PV's. Information: $1; specify interests. Lake MIchigan Wind & Sun, 3971 E Bluebird RD., Forestville, WI 54213 Phone 414-837-2267.

ALTERNATIVE ENERGY EQUIPMENT CATALOG. Everything for stand alone power generation, PV's, Hydro-Electric, Wind Generators, Inverters, Water Pumps, Regulators, Refrigeration, Tools, Books, and much more. 92 pages with design guides. $3. US, $6. foreign: WESCO, Box 936-HP, REDWAY, CA 95560

REMOTE LAND AVAILABLE through government programs. Any U.S. citizen can use these little known laws to get that place in the sun. For information send $1.00 to Ridgehaven PO Box 862 Glen Ellen, CA 95442

DISTRIBUTORS WANTED - MULTI-PURE DRINKING WATER SYSTEMS. This is the right product at the right time. Soaring demand for pure drinking water creates exploding industry. Solid opportunity with high integrity industry leader. Advanced water filters gives pure drinking water for pennies a gallon. Great support network. Full or part time employment. Write or call for free information today. Clean Water Network, POB 272C, Ashland, OR 97520 1-800-888-0905

LEARN TO TRAP, FARM, DREAM. Five Issues $9. Living Among Nature Daringly Magazine, 4466 Ike Mooney Rd., Silverton, OR 97381 Samples: $2.50.

SIBIR GAS REFRIGERATORS, solar electric systems, kits with complete directions. Photovoltaic modules, inverters, batteries. Great mail-order prices, plus expert assistance. Will beat most any sale price. State your potential need to get free catalog. Fowler Solar Electric Inc., Box 435, Worthington, MA 01098. 413-238-5974.

FUEL FROM WATER - Information and plans $1.00. HYDROGEN WIND INC., LINEVILLE, IOWA 50147.

SOLAR WATER HEATER. Antifreeze system with photovoltaic pump. You install and save. Illustrated instructions, 96 page manual/catalog $10.95 (refundable). Save On Solar, Inc., Dept. HP, 6905 White Rabbit Road, Battle Creek, MI 49017.

PORTABLE DOMES AND GREENHOUSES: 20 minutes set up! 10 to 18 foot diameter. Proven performance and reliability. Many models. Send $1.00 for catalog. SHELTER SYSTEMS, PO Box 67-HP, Aptos, CA 95001 (408) 662-2821

PASSIVE SOLAR WATER HEATERS, Grain mills, WATERLESS COMPOSTING TOILETS, PV systems, $1/watt WIND GENERATORS, DC Electric (quiet) Lawn Mowers and Tractors, Low Maintenance Batteries, Windmills. Catalog $3. Kansas Wind Power, R 1-HP, Holton, KS 66436. 913-364-4407

POSITION AVAILABLE: PV and alternative energy sales/marketing assistant with solar wholesale company in Honolulu, Hawaii. Must have experience with system design and component specification. Computer experience preferred. Call Will at Inter-Island Solar Supply for information and application. 808-523-0711.

THE SOLAR ELECTRIC INDEPENDENT HOME BOOK. 184 8.5"x11" pages, 50 diagrams, 25 photos. Installation guidelines and schematics, design, maintenance, for super-efficient Photovoltaic systems for independent homes. $15.95 + $2.00 shipping. Fowler Solar Electric Inc., Box 435, Worthington, MA 01098 413-238-5974

10KW JACOBS with Rohn Tower. Rohn VG128A top 10' section for 10KW. 3KW 110 VDC Jacobs and 4 KW 200 VDC IES. Tom Hagen, 4110 MacInnes, Anchorage, AK 99508, 907-562-5848.

HAWAII, GET YOUR PLACE IN THE SUN. 3 Big Island Kalapana lots, 1000' ele., 3 mi. from beach, 12 volt solar school bus, lots more. $7000. each. Paul Oltman, POB 574, Trinidad, CA 95570, 707-677-0951.

1989 GUIDE TO UNUSUAL HOW-TO SOURCES. Describes 50 periodicals & handbooks on backyard tech, camping, crafts, finding new friends, gardening, home education, low-cost shelters, travel, woodslore, etc. All addresses are included. Free for SASE. Light Living Library POB 190-HO, Philomath, OR 97370

3000 WATT big com. Jacobs Wind Generator. 6000 watt inverter. 40 - 6 volt deep cycle lead acid batteries and battery charger 110 volt. 100 ft. tower. All in good working order $3000.00. Martin Romberger, P.O. Box 199, Wellston, Michigan 49689, Call 616-848-4194.

OWNER FINANCE: 25 secluded acres with foundation, 10 GPM well, septic, underground electricity. IDEAL ALTERNATIVE ENERGY LOCATION! Yreka area with views of Mt. Ashland and Shasta. Call Russ at: (408) 371-2872-Days, (408) 971-1759-Evenings, Owner/Agent

FRESOURCE, SOLAR WATER HEATING APPLIANCE, received the US Department of Energy's "Energy Innovation" award, but the concept of melting wax to store thermal energy may be news to you. An appliance with Do-It-Yourself no-soldering installation, FRESOURCE attaches to your existing water heater to provide 60-90% of your family's water heating. FRESOURCE provides fully automatic energy collection, storage, and delivery with no periodic maintenance required. A complete system costs $1973, and includes 4' X 10' collector, which can be roof or ground mounted, PhaseXchanger, all connecting hardware, tubing, and antifreeze. Significant state, local or utility tax or cash incentives may apply to this purchase. FRESOURCE P. O. Box 2001 Charlotte, NC 28247 800-542-2808.

WINDCHARGER 1200 watt 24v rotary inverter $200 Heart 24v 2500 watt $500 both xlt cond. ppd David Welton 827 S 880 W, Payson, UT 84651

2000 WATT INVERTER. 48 VDC input - 110 vac output. Good sine wave. Phone Co. quality. Grossly Inefficient but rugged $400.00. 1500 watt variacs $30.00. Jerry Allen, P.O. Box 404, Republic, WA 99166

SUPER EFF. FREEZER -- 8 ft^3, 4" sprayed polyurethane over 4" cork original, water-cooled condenser, belt-drive indus compressor can use any V motor (now 120 VDC P-M), 450 W-hrs/D @70°F $950.US. R Mathews, Site 9-16, Chase, BC V0E 1M0 (604) 679-8350

ENERGY SPECIALISTS- Best available prices on alternative energy products. We carry a full line of ARCO photovoltaics, Trace inverters, Yamaha generators, Sibir gas refrigerators, hydroelectric and water pumping equipment. We have made a major purchase and are offering specials limited to stock on hand. ARCO M-75 $290, Trace 2012 $799, Statpower 100 Watt inverter $109, Sibir gas refrigerator $925, highest quality 12 Volt battery bank, 2 Volt industrial cells-900 Amp hour capacity includes steel battery case+cables compare at 1800.00 our price 975.00 For your energy needs whether it be starting a system or expanding your existing power call 916-392-7526 or write to PO Box 188710, Sacramento, California 95818

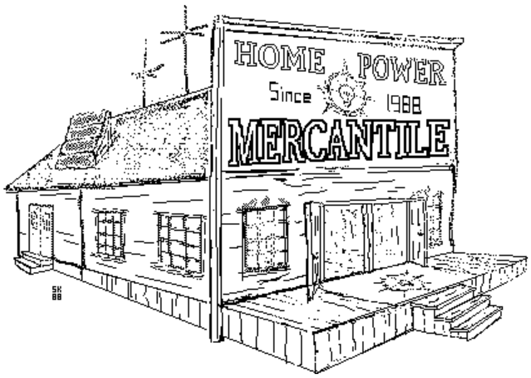
PHOTOVOLTAIC BARGAINS: ARCO M-53, 43 Watt (3 1/2 years used) $220 or $215/4 or more. Original 10-year warranty transferable. SOLAREX 35-40 watt polycrystalline, new close-out, 10-year warranty, $215 or $210/4 or more. UPS-PAID. Quantities Limited! Call (505) 753-9699. Flowlight Solar Power. See our AD on page 18.

TOPAZ UNINTERRUPTIBLE POWER SOURCE. 3500 watt capacity. Sine wave. Can be used for alternative energy invertor. Has 72 VDC internal storage with 8 hour running capability. $2500 OBO. Contact: Dorn Crowe, Rt2 Box 38, Ramah, N.M. 87321. (505) 782-4719.

"PLACES RATED ALMANAC". 329 areas in U.S. ranked & compared for climate, housing, health, crime, transportation, education, the arts, recreation & economic outlook. Ideal to help you find your hidden paradise. Soft cover, 448 pages, $10 postpaid. Rainbow, 447 Hwy 71 W, Bastrop, Texas 78602.

HOW TO BUILD THE 5,000 GALLON FERRO-CEMENT WATER TANK that needs no building permit and lasts 7 generations. Complete full sized step by step instructions. $10.00 RIDGEHAVEN, POB 849, Glen Ellen, CA 95442

WANTED, INVERTER, input: 120 VDC, output: 120 vac. Gilles Beauchamp, 111 Rang 4 Gravel, Quebec, Canada, J0W 1C0. (819) 587-3790.



Solar Retrofit Consortium

Specialists in 12 VDC Systems Worldwide

• Fluorescent Lighting • Pumps • Refrigerators • PV Panels • Batteries• Fans
Catalog $5, deduct $10 from 1st order. No Minimum
200 E. 71st St.
New York, NY 10021-5138 USA • 212-517-3580

Site Evaluations • Installations

INDEPENDENT POWER & LIGHT

PV & Hydro Systems, Winco Generators, ARCO, Sun Frost, Trace, Heliotrope, Trojan & others.
RR1, Box 3054, Hyde Park, VT 05655 • 802-888-7194

KNOWLEDGE IS POWER

photovoltaics how-to books from
aatec publications

write or call for free brochure
aatec publs. box 7119, ann arbor, mi 48107 • 313-995-1470

PETE'S SOLAR SLOW-COOKER

Kits•Accessories•Ready-To-Use
Plans $2.00 Free Information

Spotlight Marketing, Inc.

4609 Seagraves, Joplin, MO 64804 • (417)624-8923

Energy Efficient Refrigeration.

Most models powered by less than 3 PV Panels, 12 or 24 VDC
"Things that Work!" tested by Home Power

Sun Frost

POB 1101, Dept. HP, Arcata, CA 95521 • 707-822-9095.

>> KYOCERA 48 WATT PV MODULES <<
SPECIAL–– $279.95 ––PREPAID

UPS DELIVERY INCLUDED IN CONTINENTAL U.S.
SYSTEM ELECTRIC (802) 626-5537
OUR SECOND DECADE IN ALTERNATIVE ENERGY
BOX 67 LYNDON, VERMONT 05849
REGULATORS • RACKS • PANELS • INVERTERS

Sunrise Coffee

Daybreak Energy for your Cup!

We custom roast the finest coffee to the peak of perfection.
Try our blends: Bread & Roses, Port Townsend & Espresso.
Five pounds of your choice, roasted the way you want it for $33.50 postpaid.
Sunrise Coffee Company
POB 319, Port Townsend, WA 98368 • 206-385-4117

HARRIS HYDROELECTRIC SYSTEMS

High Quality Water Powered Battery Charger

from $595. • Free Sizing Information
632 Swanton Road, Davenport, CA 95017

Jacobs Wind Electric Replacement Parts

BLADES • GOVERNORS • MANY USED PARTS • TOWERS • INVERTERS • AREOMOTOR WATER PUMPERS • PV MODULES • BATTERIES
send $1. for info; specify interest

LAKE MICHIGAN WIND & SUN

3971 E. Bluebird Rd., Forestville, WI 54213 • 414-837-2267

Index to Advertisers

Home Power Magazine
POB 130
Hornbrook, CA 96044

Bulk Rate
U.S. Postage Paid
Permit # 5
Hornbrook, CA 96044