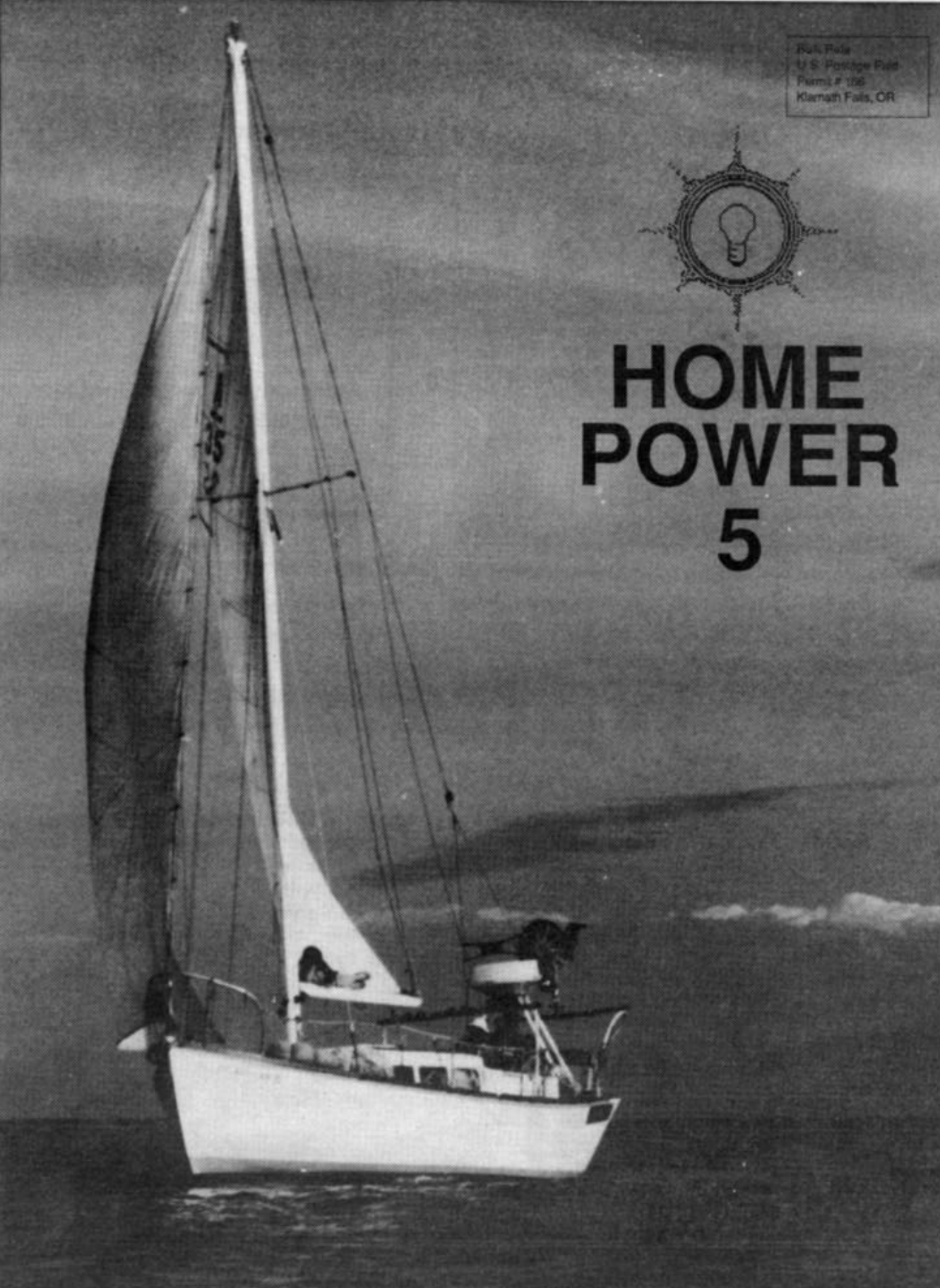

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Think About It

"Don't fight forces; use them."

Richard Buckminister Fuller

Cover

The *Agua Alegre*- a floating wind system.
Photo by Brian Green

Home Power is produced using ONLY home-made power

What's HOME?

Home Power. The Power of Home. We've been talking on these pages about Power. Let's give some consideration to the idea of HOME. I ask you to think of your Home. Define your home within your mind's eye.

Home is where the Heart is. Our homes are the most important, warmest places on this planet. It's where our family and friends gather to share our lives. We all feel the same about our homes, but when we think about "HOME" we each think of a different place. Some of us live in buildings on the earth, some of us live in RVs that roll down the road on wheels, and other's homes float on water. Radically different situations that are really all the same place- HOME.

We can define the idea of Home by what happens there. We can all agree about activities that are suitable in our homes. Staying warm, fed and rested are activities that we all do at home. We may also agree on activities that we don't want at home. War, radiation and pollution are things none of us want in our living rooms.

We must expand our idea of Home to include this entire planet. We don't live in a home, we share a planet. "Mì casa es su casa" for real. Technology leaves us no choice but to expand our concept of Home. Communication makes this expansion possible.

What are we doing to our Home in the pursuit of electricity? We know the all too familiar details of the waste and pollution that threaten our Home. It is enough here that we realize that these problems exist and are critical to the continued survival of our planet.

Those of us using the sun, wind and falling water for electricity know first hand that electrical energy production doesn't require pollution. We need to communicate our experiences to others. As home power producers, we are in a unique position to enlist the aid of others.

When Karen and I moved to the Mountains over 18 years ago, it was to leave things like politics behind. As the years have passed, I have realized that we are all in the same situation. It doesn't matter where we live, how we live, or even why we live. We are all sharing the same Home. If we have to influence the biggest industry and government ever on this planet to protect our Home, then so be it.

We need to put as much pressure as possible on governments and the electrical power industries to make some essential changes. If we don't do it, then who will? If we don't do it, then what kind of a Home will our children have?

Here are some arguments in favor of using renewable energy sources to produce our electricity.

1. The development and use of renewable energy resources makes good solid financial sense. If the real costs (including environmental clean-up costs) of commercial power are considered, then the renewable alternatives are cheap by comparison.

2. The development and use of renewable energy sources is politically good for the country. Renewable sources reduce our dependence on foreign energy supplies.

3. Renewable energy sources are good for our environment. We have already demonstrated the clean nature of solar, microhydro, and wind power. Only these types of sources now offer us long term, non-polluting, energy.

4. Research and development in renewable energy will produce spin-off technologies that will benefit every lifeform sharing our fragile environment. For example, consider solar powered water pumping for arid areas.

5. Immediate energy/environmental relief can be found by reinstating energy tax credits to individuals and businesses. Government should encourage everyone to use renewable, clean, energy resources, and financially reward those who do.

We can use these arguments on Senators, Congressmen, or any elected official (federal, state, or local) that may be able to influence how we make our electricity. It's not easy to talk energy to these folks. Not many elected officials seem concerned with energy issues in these times of "cheap" oil. We can let them know that there are alternatives and that we support these alternatives. We, as home power people, are in a unique position to speak for renewable energy from personal experience.

We at Home Power think that this issue is so vital that we are communicating our experiences to our government. We are writing our officials and letting them know that we are not only concerned about these problems, but that we also offer real workable solutions to our energy dilemmas. On pages 25 and 26 of this issue there is a letter directed at those who influence our energy policy. If you'd rather not write your own letter, then please use this one. Please take time to write the officials of your choice. A list of officials responsible for Energy Matters can be found on page 44 of this issue.

We must make it plain to our elected officials that we consider energy a serious issue even though they may not, and that we will vote our energy policy at the ballot box.

Home is Earth. If you rearrange the letters in Earth you'll get Heart.

Rich, Karen & the Home Power Crew.

So what can ONE person really do, anyway?

Richard Perez

It's easy for us to sit on our hands and bemoan our fate and the fate of our planet. What can we do? We are only individuals. How can we possibly affect the powerful megastructures that run our lives and our environment? Well, here is what one person, Mary Duffield, is doing.

Meet Mary

Mary Duffield is a retired English teacher living in Santa Cruz, California. She has spent many years living on sailboats and thereby making her own power. At 70+, Mary has more energy than most folks half her age. She uses this energy to foster communication about the issues that affect us all, topics like the environment and what we're doing to it. Mary's energy and strength comes from her ideas and her faith. She has more faith in us as human beings, and our ability to do whatever we set our minds to, than any person I have ever met.

Mary works with children, as a volunteer, teaching Ham radio communications in the Santa Cruz school systems. It is in her work that Mary really sparkles. You see, she has some really strange ideas. She thinks our kids are rational human beings. She thinks that by listening to the younger inhabitants of this planet, we may discover things we have forgotten or never even knew. Mary believes that if enough of us (and she really means everyone in this us) get together and talk things over, we can solve any problem that we might confront. You know, I think she may be right.

Mary is a Planetary Citizen. She knows that this entire planet is her Home. And as such, she would no more dump waste overboard from her boat, than she would in your (our?) living room. In Mary's words, her goal as a Planetary Citizen is, "To serve as an international network through which the unified thoughts and actions of Planetary Citizens are effectively working against such common threats as hunger, war, overpopulation, and pollution." You might expect a sermon from one of such lofty goals, but with Mary you get a smile and a warm glow.

Mary Duffield aboard
the *Agua Alegre*

Mary works with kids. In a society filled with all types of discrimination, Mary works with probably the most discriminated against minority— children. These children, by virtue of their naivatee, have been able to accomplish what adults have not. As proof of Mary's ideas, I offer what her students have accomplished.

Children, Clean Water, & Ham Radio

Mary teaches Ham Radio communication to children. Now, anyone who has taken an Amateur Radio exam from the FCC knows that these tests are tough. Many adults have trouble with the radio theory, law, and Morse code. Well, Mary's got children in their early teens passing these exams. But the Ham license is just the beginning for Mary's students. With the Ham license and equipment comes the ability to communicate with other Hams all over the World. It is this communication, and what may spring from it, that Mary and her students are really interested in.

Consider this solitary example. Mary's students are concerned about the quality of water. Their idea was to set up an international teleconference via Ham radio to talk to other students about water quality. These students, all of Junior High school age or less, arranged an international conference between student Hams in Scotland, West Germany, New York, Canada, Denmark, Japan, Washington D.C., Arizona and finally Santa Cruz. The topic was water quality. The Santa Cruz students sent water test kits to all these locations. The students gathered around their radios with the results of the water tests they conducted in their individual locations. The students agreed that everyone

Mary Duffield and her students at Del Mar Middle School in Santa Cruz, CA. Two students pictured above, Jerry Reid (KB6VKX) & Mike Kirkham (KB6WTR) are 13 years old. Jerry Reid is actively teaching other young folks the art and science of Ham Radio. The day this photo was taken the students made contact with King Hussein of Jordan!

would help the group that had the worst water to clean it up. As a 15 year old student, Betsy Baily put it, "We all agreed we would test our own water and start helping work on it. We wanted to cooperate globally to help whichever school has the worst problem, which turned out to be the school on the Indian reservation in Roosevelt Town, NY."

The students discovered that the water supply to the Freedom School on the Mohawk Indian reservation in upstate New York was contaminated with lead and PCBs. The students at this school were slowly being poisoned every time they drank a glass of water. This was discovered by a group of children globally linked via radio! The pollution in this case is so severe that if a child had eaten as few as eight tomatoes from their school garden, it could have been fatal.

The students were not content to just discover the pollution, they had to clean it up. And they were at least partially successful. They deluged the powers that be with letters and shamed them into acknowledging and fixing the problem. The Freedom school now has its drinking water trucked in from an uncontaminated source. Plans are underway to move the school to a more healthful site. All this accomplished by children using Ham radio to talk about water problems.

Now children don't burst with political or social power. They don't even get to vote. But by the strength of their moral arguments, their organization, and their maturity, they succeeded in making real changes in the water pollution poisoning the students at the Freedom School. If a bunch of kids can accomplish this, then what can all of us together accomplish? It makes one wonder.

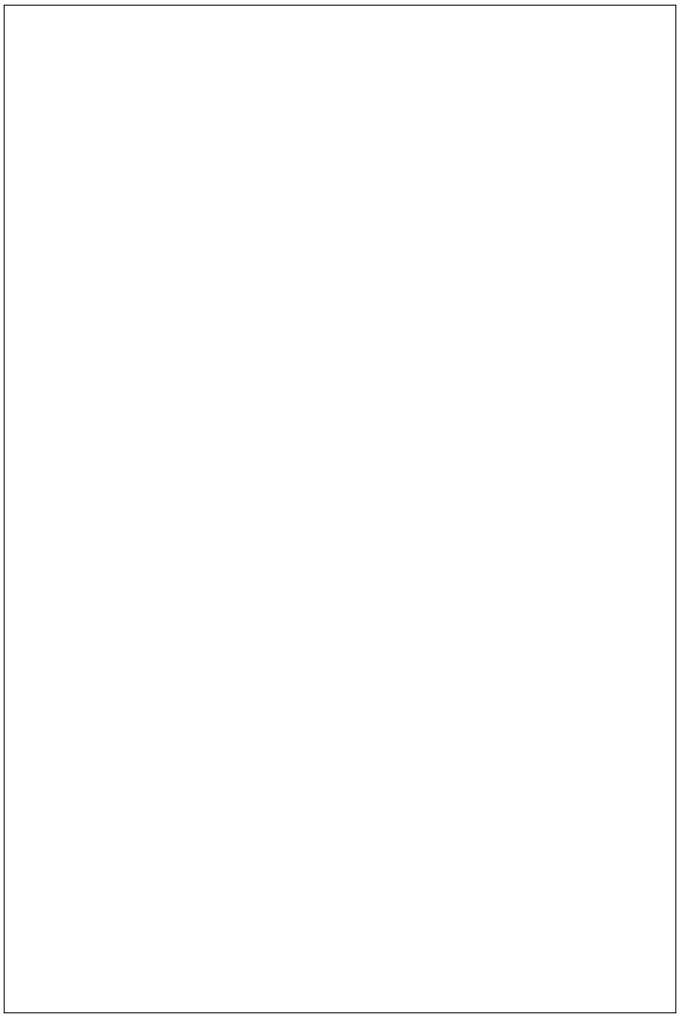
The *Agua Alegre*-- Floating Self-sufficiency

Mary's boat, a 35 foot wooden Alden sloop, is the focus of her activities. Mary's floating Home shares the same waters that nourish us all. Its power is the wind. When we visited Mary in Santa Cruz, we were treated to a short sail that gave us the photo you see on this month's cover. Well, sailing a boat is nothing new to me. But sitting and watching Mary's crew certainly was. None of the crew of the *Agua Alegre* (that's Spanish for Happy Water), on that day, were old enough to vote. Our skipper, Todd Meyers (KB6VOQ) was only seventeen years old and his crew (both Hams also) of two were both under 16 years of age. These youngsters not only sailed the boat, but amazed me with their grasp of ecology and their concern for our environment.

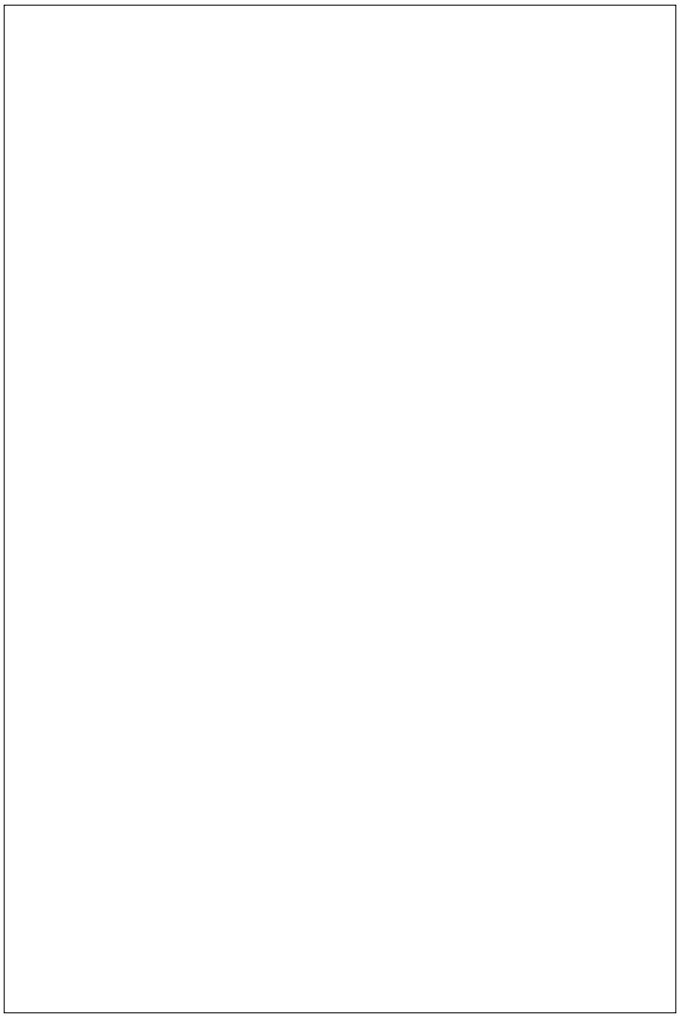
Mary uses the *Agua Alegre* as a floating classroom. Her students learn ecology, sailing, navigation, and Ham radio while on board. Her students are allowed on cruises only if they are passing in their regular academic work. The student crews of the *Agua Alegre* maintain the boat themselves. The students raise the money for docking fees, food and operating expenses through their own labor at paper drives, raffles, and other money raising activities.

Through sailing the *Agua Alegre*, Mary's students learn self-sufficiency. They stand watches, during which they, alone, are responsible for the safety and management of a sailboat under way. These lessons are not wasted on children. They are lessons we all must learn. These kids are lucky to have Mary there to give them the opportunity. So far Mary, her students and the *Agua Alegre* have completed four long distance cruises. Imagine Mary and her students sailing to such places as Venezuela and Alaska.

The Redwood Youth Foundation



Todd Meyers (KB6VOQ) at the helm of the *Agua Alegre*



Students at Loma Prieta High School in Santa Cruz, CA tune in the world via Ham Radio

So now you've got an idea of what Mary's doing. And maybe you've got a glimmer of why she's doing it. Well, here's the how. Communication is how Mary and her students accomplish their goals. To this end Mary has formed a non-profit organization to foster communication between children. Mary's hope for our future lies with our children. In Mary's words, "We are all one another's teacher and we become increasingly connected in the radio networks sharing communications skills with others who are cooperating to create a planet worthy of our children."

Mary and the Redwood Youth Foundation work tirelessly. And I mean tirelessly, for after spending just 26 hours with Mary in Santa Cruz, I was tired enough to want to return to something easy like making a magazine! If you want to help out (and we really should) then get in touch with Mary Duffield (WA6KFA), 2355 Brommer Street #23, Santa Cruz, CA 95062 or call 408-462-0300.

So what can ONE person really do, anyway?

Well, one person can talk to another. And they can talk to others. Before we know it we've got thousands, nay millions, talking. Talking about our future and what we will experience

The photos you see of the *Agua Alegre* and her crew were obtained by our intrepid Home Power Photographer- Brian Green. Brian is a landlubber, and his courage in climbing into an eight foot dingy, bouncing around in high seas, to capture the *Agua Alegre* is without parallel. While he got wet, he still smiled. That's Brian in the microboat, way out

when tomorrow becomes today. And it really doesn't matter who we are talking to. It may be a mover/shaker bursting with Worldly Power, or it may be a child with only the Power of youth. The concept is the same. By sharing our hopes, dreams, and nightmares we, all of us, just might succeed in creating a livable Home for us all.

A Floating Wind System

Richard Perez

For every stationary home power producer there are many who roll down the road or float on the water. Many RVers have written in requesting articles about home power systems that move. Well, here's a mobile wind system that not only makes its own electricity, but also its own motive power.

The *Agua Alegre*

The *Agua Alegre* is a 35 foot long wooden sailboat. This Alden designed sloop was built in the mid-1950s and usually is docked in Santa Cruz, California. This yacht, like most boats, is a self-contained energy unit. All electrical energy used on board is produced on board.

During long cruises on sailboats, electrical power generation can be a very real problem. The wind provides the motive power for the boat and the auxiliary engine isn't operated for many days at a time. The *Agua Alegre* shares many problems and solutions with land based systems. Every Watt-hour removed from her batteries must be replaced.

Electrical energy in land based homes is important. We rely on this energy for comfort and entertainment. The situation aboard a boat is much more serious. Much of the electricity used on the *Agua Alegre* is for critical services essential to the safety of the boat and her crew.

The *Agua Alegre*'s Electrical Consumption

Most of the energy used on board is for essential navigation and communication devices. Aboard the *Agua Alegre* battery stored energy supplies the radar, LORAN, depth sounder, marine VHF radio and several Ham radios. Running, deck and cabin lights are powered from the battery's stored energy. The

The *Agua Alegre* under sail

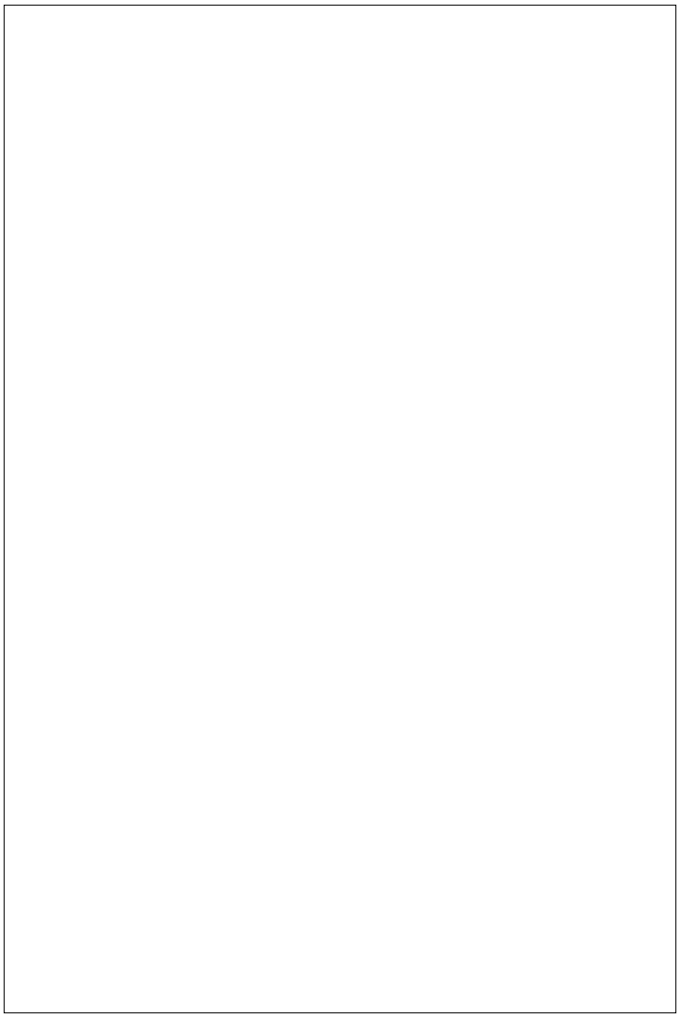
anti-electrolysis system protecting the boat's hull from corrosion and the bilge pumps are also electrical consumers.

All electrical consumption aboard is 12 VDC. The *Agua Alegre* consumes no 120 vac power and is not equipped with an inverter or ac generator. This is in keeping with the simplicity of the boat, which is not equipped with such things as microwaves, refrigeration, or other electrical luxuries. According to the *Agua Alegre*'s skipper, "If you want to survive and have fun at sea, keep it simple."

The *Agua Alegre*'s Power Sources

The primary power source for the *Agua Alegre* is the wind generator pictured below.

This simple unit was hand made for the *Agua Alegre*'s skipper, Mary Duffield, by her friend, Ted Baer (2120 N. Pacific Ave #61, Santa Cruz, CA 95060 or call 408-426-1304). The wind generator uses simple components like a bicycle wheel assembly and a permanent magnet DC generator to directly recharge the batteries. During the time I spent on board the wind generator was continually operating. Eventhough the generator only supplies a few amperes to the batteries, it is almost constantly operating. It supplies more than enough energy to light and maintain the boat when docked. In fact, while docked Mary doesn't even bother to plug into shore power. While sailing the wind generator produces enough energy for intermittent radar operation and constant operation of communication equipment.

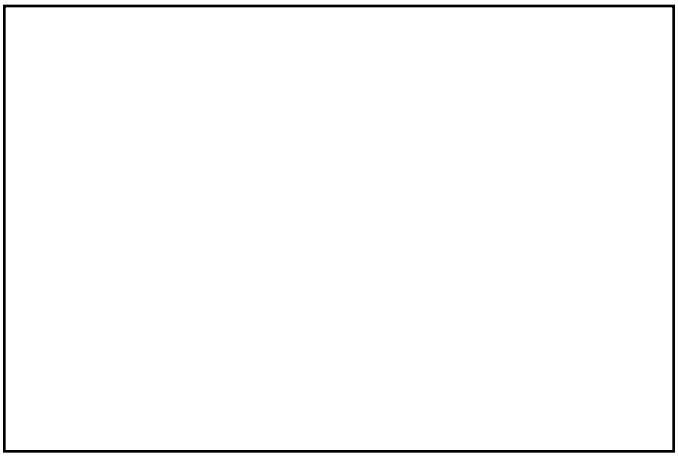


The *Agua Alegre's* windgenerator
keeps her electrical systems powered up.

The second power source aboard the *Agua Alegre* is her diesel auxiliary engine. When operating, this engine spins a 50 ampere alternator. In the days before the *Agua Alegre* was equipped with wind power, the diesel had to be run every few days while the boat was at sea. In order to shorten the periods of engine operation just to recharge batteries, Mary installed a Mk. VI Field Controller (see Home Power #2, page 23) as a replacement for the standard voltage regulator. This field controller enables faster and more efficient refilling of the batteries because it is both amperage and voltage adjustable by the user. During the four years that the Mk. VI has lived in the *Agua Alegre*'s engine compartment it has done its job without any problems.

The *Agua Alegre's* Engine Compartment
complete with batteries and Mark VI field controller.

Mary is considering adding a PV or two panel to the *Agua Alegre*'s electrical system. There are times when the wind completely stops and the boat is becalmed. In this case, a PV



panel could supply the electricity essential to navigation and communication without running the diesel auxiliary. During our visit to the *Agua Alegre*, I checked out many sailboats on the Santa Cruz Yacht Harbor. I was surprised not to see a single PV panel anywhere. In this, the "salties" could learn a thing or two from their landlocked RV cousins.

Energy Storage– The Batteries

The *Agua Alegre* is equipped with two completely separate battery banks. This approach always assures one full battery pack to start the engine, and is common in most mobile systems. A special switch allows the engine to charge or be started from either or both battery packs.

Each battery pack is composed of marine, lead–acid, batteries and has a capacity of 220 ampere-hours at 12 VDC. These

batteries are securely mounted in waterproof cases, low and in the stern of the boat. Placement of batteries in any moving vehicle, especially sailboats, is critical. Since the batteries are very heavy, they should be located as low as possible and as close to the vehicle's center of gravity as possible.

The System
The *Agua Alegre* is a wonderous and harmonious system. Brian Green and I spent the night aboard, safely tucked in her wooden belly. A small storm was brewing and the wind machine on the fantail was working overtime. As I went to sleep, thoughts of the power of the wind went through my mind. What a wonderful planet we live on. Nature is very kind to the *Agua Alegre*, she moves her through the water and supplies the energy to keep her batteries full. I had very pleasant dreams.

NEWS…

OFF-THE-SHELF PV CELLS POWER U.S. ENTRY IN SWISS RACE

A car designed & built by Dartmouth College students will compete in the 4th annual running of the Tour de Sol, a 6 day race for solar powered vehicles from Zurich to Lausanne, Switzerland, ending July 3, 1988. The PVs for the vehicle are standard models from Heliopower, Inc., Piscataway, NJ. Call 201-980-0707 for more info.

The *Agua Alegre* under the wind's power, outward bound from Santa Cruz.

Operating Voltages Revisited

J. Michael Mooney

A regular topic of discussion in HOME POWER is the selection of operating voltages for the alternative energy powered home. Excellent writings in recent issues by Windy Dankoff have done much to identify problems and suggest solutions. Well, here's more…

In 1985 the power loading for a full-size, fully equipped, fully independent AE home was over 6 KWH, today it is under 5.5 KWH, and will plummet to near 4 KWH by 1990. Selection of operating voltages should be considered with a view down the road to our destination.

The amp/capacity, or "ampacity" for DC systems of reasonable size has long been established. As loads go up, the voltage level must be raised or the wire must be increased times the square of current.

Expressed in terms of A/H/Day and KWH/DAY consumed, the table below describes the upper daily load limit for each operating voltage.

Table 1

Voltage Level vs. Daily Max. Load

DC System Voltage	Maximum Amp-hrs./day	Maximum kWatt-hrs./day
12	250	3
24	250	6
32	281	9
36	333	12
48	333	16

Since our full-size wilderness home is to consume about 5.5 KWH per day, the formula suggests a minimum operating voltage of 24 VDC. We also see that we are crowding the upper limit for that voltage.

In 1882 as we proceeded to wire our nation for electricity, the same problem surfaced. Amp/capacity or "ampacity" requirements seemed destined to drive voltage levels higher than wanted, or needed, to power appliances.
Thomas Edison, though a DC advocate, solved the dilemma by devising the three wire "WYE" (240-neutral-240) circuit which feeds AC powered homes to this day. The technique allowed voltage levels to be raised from 120 to 240 volts in order to meet ampacity requirements, then split into two 120 volt "legs" for appliances.

Heavy loads such as boilers, electric stoves, motors, compressors, etc. were powered at the 240 volt level. Lighting, well sockets, and portable appliances were powered at the 120 volt level.

We have come full circle in that our "off the shelf" DC appliances favor the 12 volt level, and ampacity is calling for 24 volts. DC does not lend itself to Edison's wye circuit, but we will accomplish the same result by simply splitting our photovoltaics, battery bank, and load distribution to produce a dual voltage (12 & 24 VDC) system.

The use of readily available 24 VDC lighting fixtures and a 24 VDC inverter will enable us to power main lighting and all AC loads from the 24 volt power bus. Wall sockets, small appliances, and table lamps will be powered at the 12 VDC level.

Low voltage and cordless appliance technology is rapidly shifting loads away from the inverter bus, and onto the 12 volt DC bus. In three years time the number of appliances on the list will grow and the overall load will shrink.

By 1990, the 12 VDC bus will be at 1500 watts, the 24 VDC bus at 2500 watts, (4 KWH total). Very few appliances will then be powered through the inverter.

APPLIANCE	Device Wattage	Run Hours per day	12 VDC Bus W.-hrs.	24 VDC Bus W.-hrs.	24 VDC Inverter W.-hrs.
Water Pump	300	1.00			300.00
19" Color TV	60	1.00	60.00		
AM/FM/Stereo Tape	10	10.00	100.00		
Lights (Fluorescent)	150	3.00		450.00	
Lamps (Fluorescents)	27	3.00	81.00		
Cellular Telephone	0.4	24.00	9.60		
VCR	30	0.50			15.00
Electronic Keyboard	10	0.50	5.00		
Electronic Security	3	12.00	36.00		
Microwave Oven	850	0.50			425.00
Dishwasher	1500	0.20			300.00
Can Opener (cordless)	13	0.05	0.65		
Blowers & Fans	225	4.00		900.00	
Mixer (cordless)	13	0.08	1.08		
Coffee Pot	575	0.50			287.50
Toaster	1500	0.10			150.00
Blender (cordless)	13	0.10	1.30		
Iron	1500	0.20			300.00
Washing Machine	450	0.50			225.00
Gas Clothes Dryer	250	0.50			125.00
Vacuum (cordless)	30	0.50	15.00		
Computer/Printer/Monitor	80	4.00			320.00
Hair Dryer	1500	0.15			225.00
Curling Iron	750	0.15			112.50
Jacuzzi	750	0.15			112.50
Waterpik	96	0.40			38.40
Bench Grinder	235	0.10			23.50
Drill (cordless)	13	0.05	0.65		
Black & White TV	30	1.00	30.00		
Satellite TV System	16	4.00	64.00		
Skil Saw (cordless)	18	0.05	0.90		
Cooking & Baking	gas				
Clothes Drying	gas				
Water Heating	gas				
Space Heating	gas				
Refrigerator	gas				
Freezer	gas				
		sub total	405.18	1350.00	2959.40
	10% system loss		40.52	135.00	295.94
		sub total	445.70	1485.00	3255.34
		12 VDC Tota	445.70		
		24 VDC Tota		4740.34	
		HOME Total	5.19	kiloWatt-hours/day	
	12 VDC Amp-hrs. per day		36.24		
	24 VDC Amp.-hrs. per day		189.61		

Design, Construction & Operation of a PV/Hot Air Hybrid Energy System

Richard Komp and Terry Reeser

Abstract
For a passive dwelling in Louisville, Kentucky, we have developed and are constructing a linear concentrator array. It is built into the roof structure of an attached sunspace that uses natural convection to extract excess heat from the fin module assemblies and deliver that heat to the home in the winter. In the summer, the heat is exhausted from clerestory windows, creating a draft of cooler air into the lower part of the building. The 17m x 2.5m array containing 72 fins with compound curved collectors of 2/1 ratio arranged vertically at a slope angle equal to the 38° latitude of Louisville. It was constructed at the site using 100 mm round single crystal photovoltaic cells imbedded in silicone resin onto aluminum fins for good heat transfer. The entire array will have a rated output of 2.5 kiloWatts. The power is fed to a 3500 Ampere-hour 12 VDC storage battery bank and can be delivered either directly to the low voltage lights and appliances in the home or to a 1200 Watt Heart Interface inverter for conversion to 120 vac. Uses of the power include running an IBM PC and a small plastic injection molding machine as an income producing cottage industry. This remote site has no utility power available.

Introduction and Objectives
Photovoltaic modules are becoming an attractive alternative source of electric power for remote homes but the high cost of the systems is delaying the implementation of this new technology. Since the main cost of the modules is that of the solar cells, concentrator designs that increase the output of each cell are a desirable way to decrease the cost per watt. Linear concentrators can operate at a ratio of up to 2/1 without need of any tracking arrangements. Care must be taken in the design to arrange for dissipation of the heat generated within the cells.

Table1– Photovoltaic Home System Sizing Calculation

Location: Louisville, KY, USA
Peak Hours: 5.5 • System Voltage: 12 VDC • Approximate kW.-hrs./day: 8.09
No. of Occupants: 4 • No. of Bedrooms: 2 now (3 later) • Inverter Efficiency: 90%

			Expected Winter		Expected Summer		Actual Present	
Load Name	ac/DC	Wattage	Hours	Watt-hours	Hours	Watt-hours	Wattage	Watt-hours
Refrigerator	Gas	0	6	0	8	0	0	0
Lights, General	DC	125	6	750	5	625	30	150
Lights, Living Room	DC	85	5	425	4	340	20	80
Lights, Bed/Bath	DC	75	3	225	2	150	15	30
Lights, Kitchen	DC	100	4	400	3	300	15	45
Stereo	DC	5	5	25	5	25	5	25
TV	AC	60	6	400	5	333	60	300
Water Pump	DC	60	0.4	24	0.4	24	60	24
Power Tools	AC	200	0.5	111	0.6	133	150	100
Washing Machine	AC	250	0.2	56	0.3	83		0
Computer	AC	60	3	200	3	200	60	200
Satellite TV Dish	AC	35	3	117	2	78	35	78
VCR	AC	40	2	89	2	89	40	89
Plastic Molder	AC	300	1	333	1.5	500	300	500
	kW-hr. per day →			3.15		2.88		1.62
	kW-hr. per month →			95		86		49

Vertically oriented, passively cooled photovoltaic fins with linear curved concentrators were incorporated into the design of a new solar home being constructed by Terry Reeser near Louisville, Kentucky. Although the site is near a major urban area, it is located almost a kilometer from the nearest utility line. Installing conventional power would have been expensive. The first step in the design of such a system is a calculation of the expected power needs; Table 1 shows the expected and actual load requirements of the remote home.

In addition to being a dwelling, the structure also serves as the base for two cottage industries. The computer is used to develop record keeping programs for a chain of video tape rental stores; the programs being sent through a telephone connection to the stores. There is also a small plastic injection molding machine to make small parts that are sold by mail order. The molding machine actually draws 900 watts but has a 1/3 time duty cycle. The use of the plastic molder is expected to grow so it was decided to expand the size of the photovoltaic array to furnish more energy than currently needed.

Photovoltaic System Design

The dwelling structure is a large enclosure built around a pre-existing house trailer. The entire south facing side of the structure is a two story greenhouse/sunspace with a 17 meter long by 2.5 meter high sloping roof used for mounting the hybrid photovoltaic fins. Figure 1 shows a cross section of the structure. We used a unique photovoltaic/hot air hybrid array with linear curved concentrating reflectors arranged vertically instead of the more normal horizontal placement. Komp (1985) found that instead of the more normal ratio of 2 to 1 or less, the efficiency penalty for a vertical system is only 5% in the summer and less in the winter when the hours of useful sun light are short.

72 fins, each 2.5 meters long would just fit into the available roof space; 5 fins in each of 14 (1.2 meter) spaces between the roof rafters with 2 extra fins at the east end of the area. Figure 2 shows a cross section of a pair of fins and reflectors. The vertical oriented fins and reflectors form sloping channels for the air to rise as it is heated into the clerestory . The large contact surface area insures good heat transfer between the fins and the air. In the winter the warm air is drawn down to floor level by means of a PV powered fan. In the summer, the hot air exits through the open upper windows and the draft draws cooler air from the ground level into the dwelling. "The Solar Electric Home" (Davidson and Komp, 1983) contains practical details on the sizing and installation of this type of home PV array.

System Construction and Assembly

100mm diameter round single crystal cells were soldered into

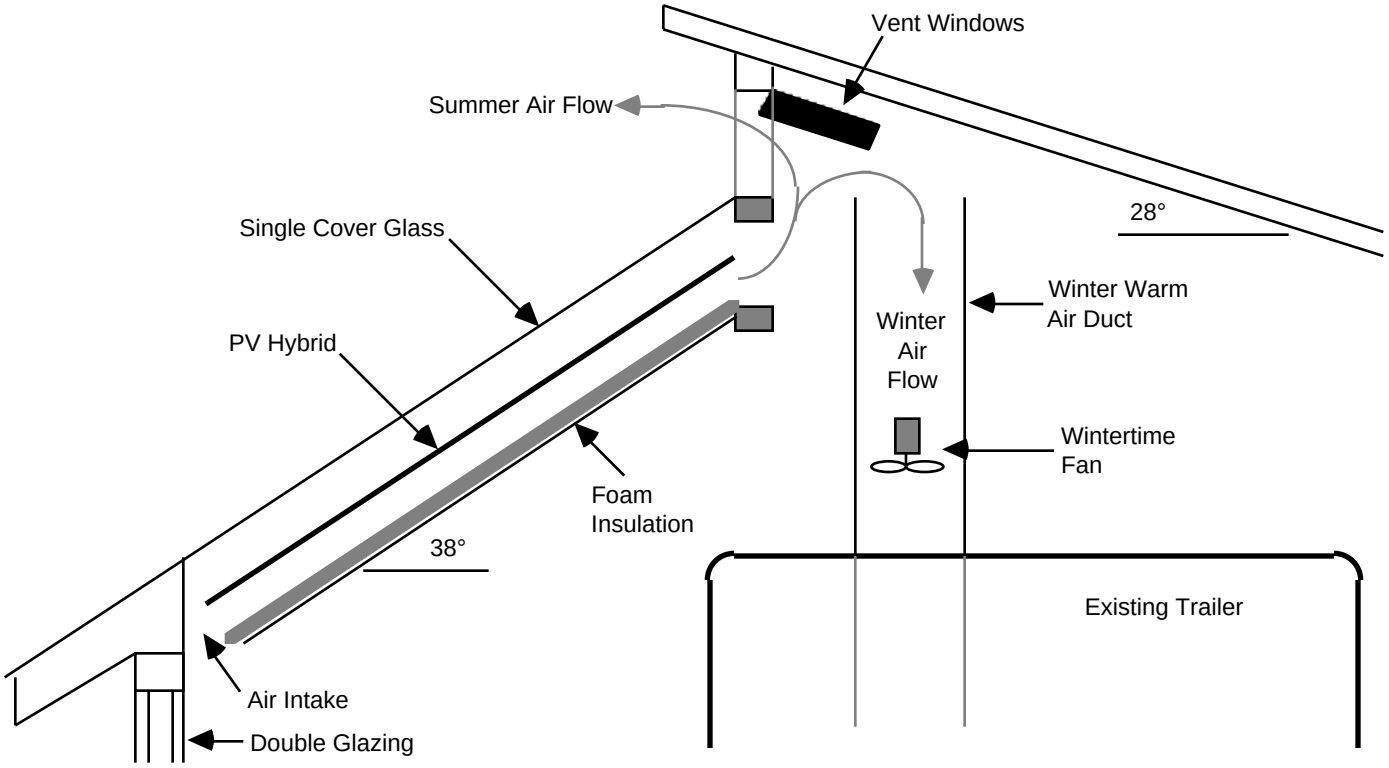


Fig. 1– Cross-section of Solar Dwelling Showing Sunspace

long strings. After being tested, the strings were laminated onto the u-shaped aluminum channels using two part catalyzed silicone resin and polyester cloth between the cells and the aluminum to insure a good thermal contact and excellent electrical insulation. Details of the array construction are given in "Practical Photovoltaics" (Komp, 1981). A rather complex wiring scheme allowed 42 strings of 36 cells each to occupy the 72 fins. Table 2 shows the expected output of the system when completed. The KWh per month expected from the array is larger than now needed but growth in the use of the plastic molding machine is anticipated.

The 12V electric power from the system is fed through a 42 line fuze array to the battery bank through two pair of 000 buss cables. Thirty-two 6V golf cart storage batteries are series/parallel wired into two separate 12V banks to facilitate later conversion to a split 24V system as the power needs increase. Right now, charge and load control are done manually by monitoring the battery voltage and specific gravity. The state of charge on such a large system changes very slowly, necessitating a decision only every two or three days.

All the lighting circuits are fed 12 VDC directly from the battery bank. This takes advantage of the greater efficiency of low voltage lighting and the better performance of high frequency fluorescent lamp ballasts. The stereo system, water pump and many other appliances are also DC powered to reduce the load on the inverter. The ac loads are fed from a Heart Interface 1200W inverter; its 3500W surge capacity allows for the starting current of larger motors. The ac wiring meets the usual US code requirements; the DC wiring is similar in the use of normal ac wire, switches and outlet boxes except that "auto cigarette lighter sockets" are used as outlets. The house trailer inside the greenhouse shell is now being modified and partially dismantled for increased interior space and as this progresses, the permanent DC wiring is being completed utilizing short runs of #12 or #10 wire to insure a low voltage drop. All DC wire connections should be soldered for low wiring resistance.

Operation Experience to Date

Since the photovoltaic array is just now being finished and only a few rows of completed reflectors have been installed, the data on power output is incomplete. However, the partial array has been furnishing electric power to the dwelling since occupation last winter. During the winter a back-up gasoline powered generator was used three times to recharge the batteries but since half of the fins in the system have been installed in March, this has been unnecessary.

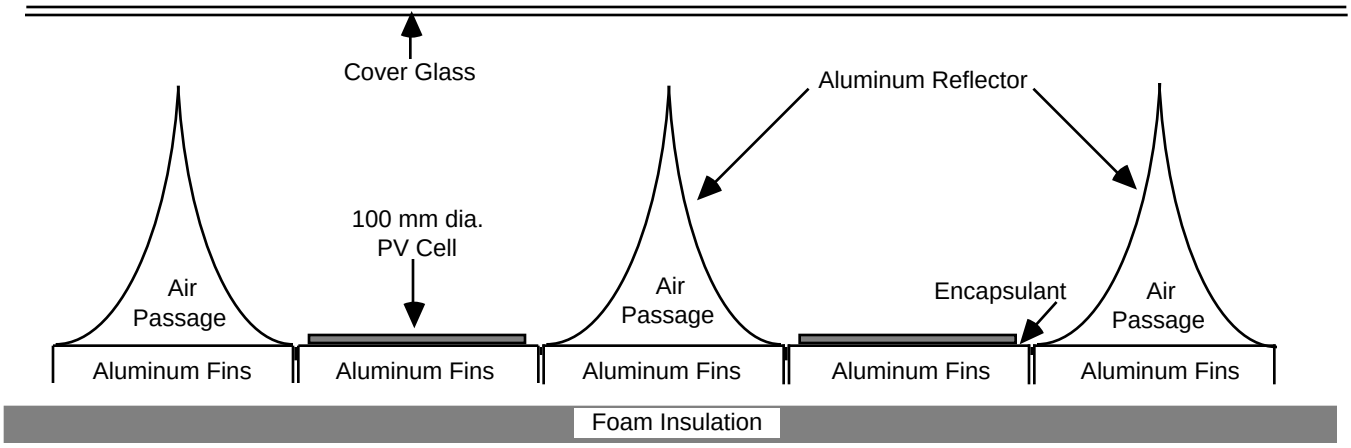


Fig. 2– Cross-section of Photovoltaic/ Hot Air Hybrid

Some measurements have been made on both the electrical and heat output of the completed section of the array. At noon (local sun time) on a hot summer day with slightly hazy sun conditions (700W/m sun intensity) a single string of cells produced 1.3A without and 2.0A with reflectors (short circuit current). At an outside air temperature of 33°C and 31°C inside the greenhouse, the air exiting from the top of the reflector air passages was 50°C, a 19°C rise in air temperature for this thermosyphon system. The final reflector fins should be in place by the end of September and accurate instrumentation of the system should produce more complete data on the operation of this unique installation.

System Cost

The total cost of the installed PV hybrid system was less than $9,000 giving a cost of only $3.60 per peak watt, but this cost is unrealistically low since the cells were purchased surplus from a solar company shut down by its oil company parent and all the module assembly work was done on site. These costs, however, are for the complete installation including the inverter and battery bank and even including a normal labor rate, the system still is cost effective compared to the alternative of bringing a utility line from the nearest existing pole.

Future plans include the installation of a wind generator for winter operation when long cloudy but windy periods are common. A combined PV/wind hybrid system is cost effective in this part of the US compared to either source of power alone. Future reports will detail the operating experience of this unusual system, believed to be the largest photovoltaic installation to date in Kentucky.

References

Davidson, J. and R. Komp (1983). "The Solar Electric Home". Aatec, Ann Arbor. Chap. 4, Chap. 5.
Komp, R. (1981). "Practical Photovoltaics". Aatec, Ann Arbor, pp. 65-88.
Komp, R. (1985). Field Experience and Performance Evaluation of a Novel Photovoltaic-Thermal Hybrid Solar Energy Collector. INTERSOL 85 PROCEEDINGS, Vol. 3, pp. 1748-1752.

Richard J. Komp works with SunWatt Corporation, RFD Box 751, Addison, ME 04606, or telephone: 207-497-2204. SunWatt Corporation, a manufacturer of PV modules is moving its entire operation to the coast of Maine. SunWatt will be operating out of a completely self-sufficient facility some distance from the nearest power line and will use alternative energy in all manufacturing processes. Initially SunWatt will be using PV and wind power, but later intends to experiment with tidal power, trying to tap the 11 foot tides in their bay.

Table 2– Expected Output of Photovoltaic/Hot Air Hybrid Array

Collector Tilt= 38° • Rated Output= 2500 Watts • System Voltage= 12 VDC
Battery Storage=10.7 days • Battery Capacity= 3500 Amp-hrs. • Electric Cost= 9¢/kW.-hr.

Month	kW.-hrs./ Month Geometric	Percent Sun	kW.-hrs./ Month Expected	Amp.-hrs./ Month	Output Value	Hybrid Heat Output in kW-hrs.
JAN	394	41	162	13468	$14.55	1713
FEB	384	47	180	15025	$16.23	1911
MAR	443	52	230	19204	$20.74	2443
APR	420	57	240	19967	$21.56	2540
MAY	405	64	259	21613	$23.34	2749
JUN	372	68	253	21057	$22.74	2678
JUL	393	72	283	23580	$25.47	2999
AUG	423	69	292	24337	$26.28	3096
SEP	429	68	292	24321	$26.27	3094
OCT	434	64	278	23146	$25.00	2944
NOV	390	51	199	16606	$17.93	2112
DEC	384	39	150	12476	$13.47	1587
Totals	4872		2818	234801	$253.59	29867

Total value of hot air with hybrid= $2,688. Dollar values are based on current Louisville, KY utility rates and do not include the avoided cost of installing the power lines to the home site.

Introducing Wind Electric Generators

Steve Willey

We started our home power system and our home energy business with small scale wind electric wind generators, simply because solar was not quite available in 1974. We are located on a hilltop with no water power or other electrical source. Our wind is not particularly good here, in fact in late summer there is NO wind for many weeks at a time. Never the less, as our only option, any help from the wind seemed better than running an engine generator. The only wind electric generating systems considered were those designed to charge a 12 volt battery since storage was necessary in our stand alone system, 2 miles from the powerlines, and we already had a generator charged battery system.

Now that photovoltaics technology is available almost anywhere, windmills are seldom used in this mountainous area with so few good windsites. We get almost all our power from photovoltaics. Still the windmills will stay in service atop their 45 foot roof platform. They are a real pleasure to see and they fill a complimentary role WORKING WITH THE SOLAR. If we have a dark stormy day, it's usually windy. A mixed source produces power in more varied conditions, which means more evenly distributed power than is possible from a single source.

Site Selection and Windspeed

When there is a question of possible wind resources on a site, I recommend starting with photovoltaics, but less wattage than is planned for the finished system size. This can be used for immediate power needs while the wind is carefully analysed for the next full year. At the end of that time you will know whether to add a windmill or more solar. It is a costly mistake to install a wind machine only to find your wind is not adequate.

I made a simple device to measure windspeed for 6 months prior to buying a windmill. The device was a giant anemometer made from three plastic toilet tank floats cut in half to form cups. A magnet attached to the wheel activated a magnetic reed switch which was connected to the "=" key of a pocket calculator. Most calculators can be made to count revolutions this way. At any windspeed, 230 revolutions represented a mile of wind passing, so each night it's easy to divide the days mileage count by 24 (right on the same calculator) to get average miles per hour windspeed. Actually such averaged windspeed can be misleading. Most windmills start generating in winds OVER 8 miles per hour. An average 7 mile per hour wind measured can represent no power if it's 7 mph all day, or the same can generate substantial power if it's 14 mph for 12 hours and 0 for the next 12. Windspeed should be read several times a day to show true hours of each windspeed. Write the readings on a calendar.

This data allowed me to select the machine that would meet my electrical needs from the available wind. In the early 70's there were lots of windmills available, almost all of which are now gone! The one I selected happened to be a WINCHARGER, a 40 year old design that is still being produced in one model.

Location

Wind turbine location is very important. If you don't have a good view of the direction of incoming wind, AND DOWNWIND TOO, your wind may be turbulent. A weather vane that changes direction more than 90 degrees most of the time is a sign the wind may not be steady enough.

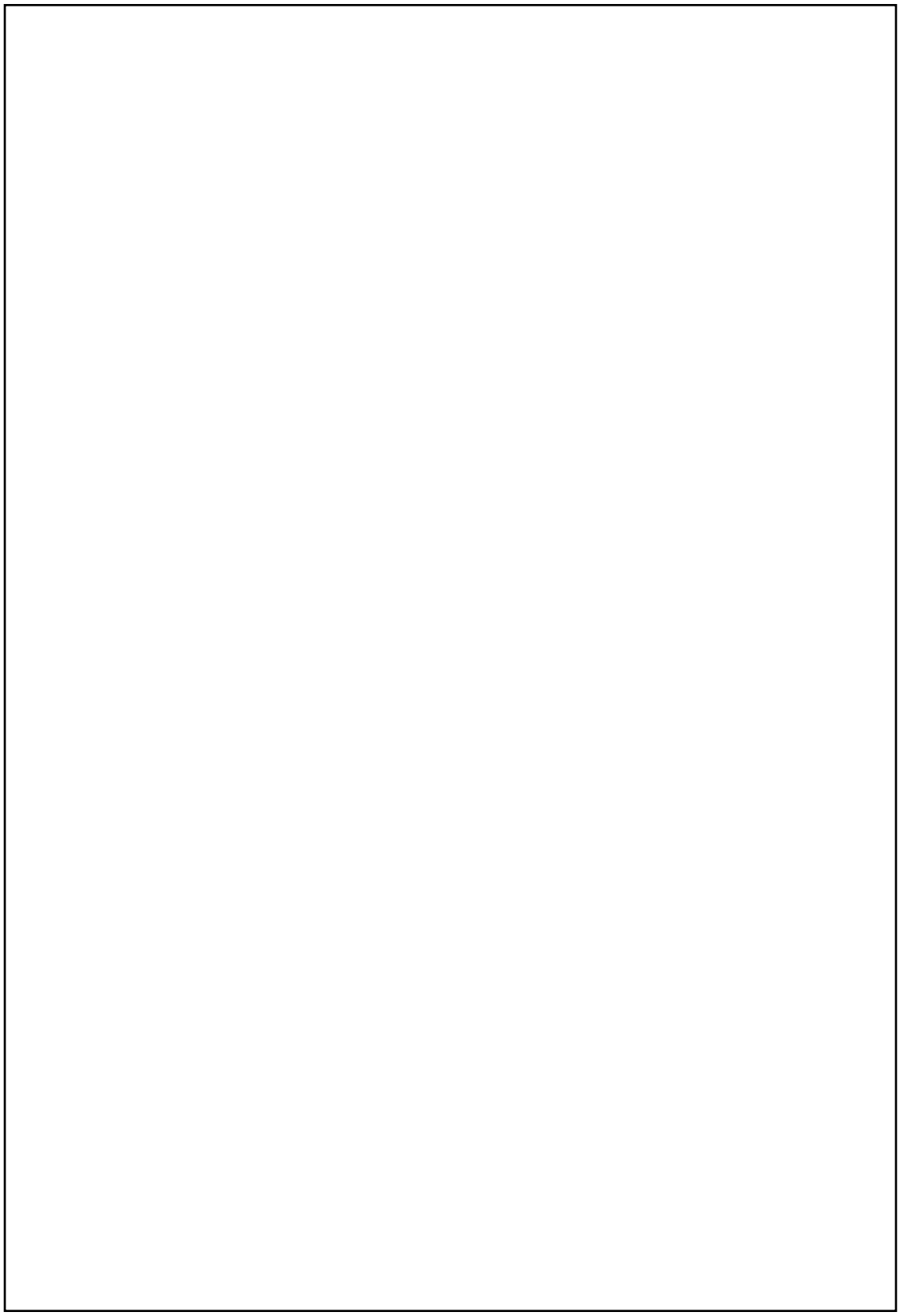
Here in the forest, it is necessary to get the windmill up above the tree height. The rule is at least 15 feet higher than anything else for 500 feet around or most of the wind will miss the generator. But watch out, your forest will grow taller about one foot a year, and your tower won't grow an inch. Plan ahead.

Triangular metal antenna towers by Rohn are a neat solution, but these towers can cost more then the windmill. Another neat solution is to mount the mill on a wood pole tower. Poles require at least 3 heavy guy wires and a welded bracket made to match the generator to the pole top. To take this another step, we used 4 poles to build an enclosed tower 10 feet square and 46 feet high, on top of which are the metal 10 and 20 foot windmill tower stubs. Later we built the house right on as an "addition" to the tower. This provided three extra rooms off the house and a porch. Now the tower platform serves to mount our solar modules as well.

When windmills are mounted on a house, out of balance blade vibration can be transmitted through the whole house. If the blade is balanced well, vibration is not objectionable. If not kept in balance, the occupants of the house have to look at their meter panel to see if the vibrations and rattles are in earthquake tremor or just the windmill spinning! We have had some strange comments from overnight guests who aren't warned.

Wiring

Wire length and size is critical on 12 volt wind units. Generally 200 feet is the maximum practical distance to run cables for a 450 watt (35 ampere) wind electric generator. Connection to the battery is independent of all other charging sources. The charge to the battery is the sum of the wind generator & any other source connected.



Steve and Elizabeth Willey's home in Sandpoint, Idaho.

Windmills must be mounted high in the open, which is also an ideal position for lightning attacks. Ours are hit regularly in spring and summer storms. The chassis of each is wired directly to the metal well casing below the tower and so far this has prevented all but minor damage to equipment in the house. More lightning damage comes in via phone line than from the windmill.

Maintenance
These smaller machines that I have are surprisingly durable. The only maintenance has been refinishing the wooden propellers every few years (or else you will have to replace it at $100. a shot). Occasional rebalancing of the blade is needed. The only parts replaced in 14 years have been one propeller, (and the old one went on to be used elsewhere), plus a couple of $5. items like brushes or a wind-direction turntable bearing.

Availability
Today there are few windmills on the market. In the $1000 or less range there there are two that give good performance. The 450 watt Wincharger is still available, with a metered regulator panel ready to connect to your battery. The famous 200 watt Wincharger has just been disconnected, but a few may be on the market still (and I have a used one on consignment here). A new company in Arizona, SOUTHWEST WINDPOWER has just introduced a 250 watt unit for $795 which will replace the discontinued 200 watt Wincharger. Smaller wattage machines I have seen are best suited for small trickle charging of batteries on boats, rather than supplying the wattage needed for a home power system, and cost is close to those listed above.

Steve and Elizabeth Willey own and operate Backwoods Solar Electric. You can write them at 8530 Rapid Lightening Creek Road, Sandpoint, ID 83864, or telephone 208-263-4290.

An Introduction to Solar Water Pumping

Windy Dankoff

Solar-electric (photovoltaic) pumping systems provide a welcome alternative to fuel burning generators, cumbersome windmills and hand pumps. A solar pump is alot like a windmill, which fills a tank when the energy is available. The BIG difference is that solar pumps don't slow down in summer, when winds are low. They provide the most water precisely when it is needed the most -- when the sun shines the brightest! Solar pumps are simple to install and maintain. The smallest systems can be installed by one person in a couple hours, with no experience or special equipment required.

While multi-national corporations commit massive resources to developing photovoltaics, small companies and private inventors are putting PV power to use in small-scale, appropriate applications. Special water pumps required for solar use are among these innovations. Solar power differs fundamentally from conventional electric or engine-powered systems, so solar pumps often depart from the conventional. PV arrays produce DC power, rather than the AC from conventional sources. And, the power available varies with the sun's intensity. Since it costs less to store water (in tanks) than energy (in batteries) solar pumps tend to be low in power, pumping slowly through the duration of the solar day.

Simple, efficient systems are the key to economical solar pumping. Special, low-power DC pumps are used without batteries or AC conversion. Modern DC motors work well at varying voltage and speed. They are more efficient than small AC motors, too. The better DC motors require maintenance (brush replacement) only after periods of 5 years or more.

Most solar pumps used for small scale application (homes, small irrigation, livestock) are "positive displacement" pumps which seal water in cavities and FORCE it upward. This differs from faster, conventional CENTRIFUGAL type pumps (including jet and submersible pumps) which spin and "blow" the water up. Positive displacement pumps include piston, diaphragm, rotary vane, and pump jacks. They work best for low volumes, particularly where variable running speeds occur. Centrifugal, jet and turbine pumps are used for higher volume systems.

Electronic matching devices known as Power Trackers and Linear Current Boosters allow solar pumps to start and run under low-light conditions. This permits direct use of the sun's power without bothersome storage batteries. Solar trackers may be used to aim the panels at the sun from morning to sunset, extending the useable period of sunlight. Storage tanks hold a 3-10 day supply of water, to meet demands during cloudy periods.
Solar pumps use surprisingly little power. They utilize high efficiency design and the long duration of the solar day, rather than power and speed, to lift the gallons required. Solar pumps are available in the power range from 1/30 to 1 1/2 horsepower. System costs range under $1000 to the tens of thousands, depending on water requirements, lift and climate.

TO DESIGN A SOLAR PUMPING SYSTEM, WE ASK FOR THE FOLLOWING DATA:

- WELL DEPTH (or description of water source)
- DEPTH TO WATER SURFACE -- Does it vary? Describe
- 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 (what kind of system)?
- Is PRESSURE required (home, sprinkling)?
- Can 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? Include map or diagram
- DESCRIBE EXISTING EQUIPMENT for pumping, distribution, storage etc.

You should provide ALL this information to your supplier when requesting a solar pump design!

If your well is near your home, and a battery system is present at the home, then it is usually most economical to run the pump FROM THE HOME SYSTEM. That way in summer, when you use less energy for lights, you have more to spare for pumping and need not add much to your generating capacity. A battery system allows you the options of pumping on demand (any time) to charge a pressure tank, and also the option of using a conventional AC submersible pump powered by an inverter -- a good option in some circumstances. And, storage tank requirements may be reduced or eliminated.

STORAGE AND DISTRIBUTION: Homes generally require some pressure for proper water delivery. When considering using an elevated tank to provide pressure, be aware that 2.3 feet of elevation is required for every 1 PSI pressure. Conventional "Town Pressure" is 30 to 60 PSI -- over 100 feet! In most cases, it is FAR CHEAPER to obtain pressure using a DC PRESSURE (BOOSTER) PUMP charging a conventional

pressure tank. The booster pump runs from the home battery system, as usage demands. Energy requirement is generally less than that supplied by one PV panel, for typical family requirements.

An exposed storage tank will be subject to freezing in most parts of North America. We favor BURIED storage tanks made of food-grade polyethylene (like a giant milk jug) combined with a booster pump system. The buried tank keeps water cool in summer, and liquid in winter! The pump may be placed inside the house, even if it is a little higher than the buried tank. A plastic tank also costs much less than a steel one, and will last longer.

IRRIGATION should be satisfied with gravity flow whenever possible, so energy is not spent pressurizing. Drip systems can usually operate from low pressure by gravity. Irrigation water may also be supplemented by RAIN WATER CATCHMENT and storage, to reduce pumping requirements. The author catches water from 1200 square feet of roof, stored in a 3000 gallon steel tank elevated 4 feet above the ground. This has provided 95% of the requirements for 25 new trees, for the past 3 years -- in NEW MEXICO! Rain storage is also an alternative for domestic water, using a purifier, if ground water development is too costly.

For our home, we use a prototype "Hydra-Jack", a new kind of deep well DC pump. Ours draws about 3/4 GPM from a 145 foot deep well (the well only produces 1 gpm). It fills a 1200 gallon polyethylene tank that is so clean even my wife can't taste the plastic (she's very sensitive to it). A Flowlight Booster Pump provides pressure. We use about 100 gallons per day for our household of (average) 2 1/2 people. We have a clothes washer and dishwasher and an "Info" 1-gallon flush toilet.

This article is vague, of necessity -- the subject matter could easily fill an entire book AND a good sized catalog. Solar pumps are utilizing many new, innovative designs and specifications are ever-changing. For more information, refer to the latest catalogs from PV suppliers, and consult a competent solar power specialist. Watch for more articles on this vital subject in future issues of Home Power.

Windy Dankoff is owner/manager of Flowlight Solar Power, manufacturer of "Slowpump", "Flowlight Booster Pump" and "Flowlight Micro-Submersible" DC well pumps. You may reach Windy at PO Box 548, Santa Cruz, NM 87567
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I NOW use alternative energy (check one that best applies to your situation).

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

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☐ **Wind Power** ☐ **Other** _____

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☐	☐	Wind generator	☐	☐	Batteries
☐	☐	Water power generator	☐	☐	Inverter
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Dear Sir:

I am writing to make you aware of my personal concern regarding America's energy sources and our environment. I wish to support, and ask you to support, research, development, and implementation of renewable energy sources. I also ask that tax and other financial incentives be reestablished for those using renewable energy sources to make electrical power.

I offer the following arguments in support of renewable energy sources:

1. The development and use of renewable energy resources makes good solid financial sense. If the real costs (including environmental clean-up costs) of commercial power are considered, then the renewable alternatives are cheap by comparison.

2. The development and use of renewable energy sources is politically good for the country. Renewable sources reduce our dependence on foreign energy supplies.

3. Renewable energy sources are good for our environment. We have already demonstrated the clean nature of solar, microhydro, and wind power. Only these types of sources now offer us long term, non-polluting, energy.

4. Research and development in renewable energy will produce spin-off technologies that will benefit every lifeform sharing our fragile environment. For example, consider solar powered water pumping for arid areas.

5. Immediate energy/environmental relief can be found by reinstating energy tax credits to individuals and businesses. Government should encourage everyone to use renewable, clean, energy resources, and financially reward those who do.

Thank you very much for your time, attention, and consideration.

Sincerely,

Recharging Nicads using a "Pulsar"

Richard Perez

Last month's battery column introduced small nicad batteries for portable applications. This month we are going to discuss recharging these batteries with an electronic charger. This charger is user programmable to fit any of the small nicad battery sizes, either in singles or assembled into packs. It is efficient and extends the battery's lifetime by proper recharging. Read on for how to build your own "Pulsar".

Requirements for recharging nicads

Any machine that is designed to recharge nicads must perform one basic function. It must limit the amount of power, per unit time, flowing into the nicad. This is essential to keep the nicad from overheating, overcharging, and eventually being destroyed. In last month's column, power control was accomplished by using a resistor to limit the amount of current flowing into the nicads. This month we are taking a different approach to the problem. The power flowing into the nicad is controlled by electronically switching a semiconductor junction on and off.

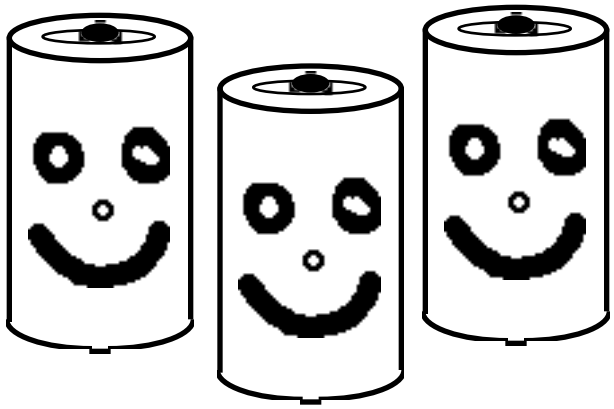
Using pulses to control power

The concept involved here is really quite simple. Let's consider this analogy. Imagine a lightbulb hooked up to a battery with a switch in line. This situation is exactly the same as the lighting circuits you use in your home. Turn the switch on and the lightbulb lights. Turn the switch off and the lightbulb ceases its operation.

Now consider turning the switch on and off rapidly, say about 200 times per second. Let's say that the switch spends half its time ON and half its time OFF. The result will be a dimming of the light as the switch is rapidly turned ON and OFF, or pulsed, in electronic jargon. The lightbulb has the amount of power flowing through it controlled because the light is only consuming power half the time and the remaining half the time, the light is off. This technique of controlling power by rapidly switching the load on and off is called Pulse Width Modulation (PWM). Now, 200 times a second is a little too rapid for a manually operated switch, besides it's just plain boring to stand there and switch something continually ON/OFF just for control. So instead of a manual switch, let's use a transistor as a switch. PWM, using transistors, is extensively employed in the electronic power control of many devices/processes like lighting, motors and in our case, recharging batteries.

Power is controlled by the amount of time that the electronic switch spends on in relation to the amount of time the switch spends off. This ratio is called "duty cycle" and is expressed as a percentage of ON time divided by ON time plus OFF time or in algebraic terms:

Duty Cycle = ON time / (ON time + OFF time)



Nicads enjoy Pulse exercises, being fit and full,
they live longer too!

If the electronic switch spends half its time ON, and consequently half its time OFF, then its duty cycle is 50%. If the switch is ON 1/4 the time and OFF 3/4 of the time, then the duty cycle is 25%. And so on…

The actual amount of power available from a PWM is influenced by one more factor, the voltage (or amplitude of the pulse). This is the voltage that the pulse attains when in the switched ON condition. A pulse may attain any ON voltage that we desire, it could be 1 volt, 5 volts, or 10 volts, or whatever. Consider two separate pulse trains, each with a 50% duty cycle. A sequence of regularly spaced pulses is called a pulse train. One pulse train has 5 Volts supplied to the switch, while the other has 10 Volts available for switching. Given the same duty cycle, the power content of the pulse train switching 10 Volts is twice that of the PWM supplied 5 Volts.
This then is the whole story; power can be controlled by two factors in a PWM. The first is the duty cycle of the pulse train, and the second is the voltage of the pulse when it is switched ON. Now, the math involved here can get sticky (it is best described by calculus), but the idea can be very simply expressed in a diagram. Consider the illustration below.

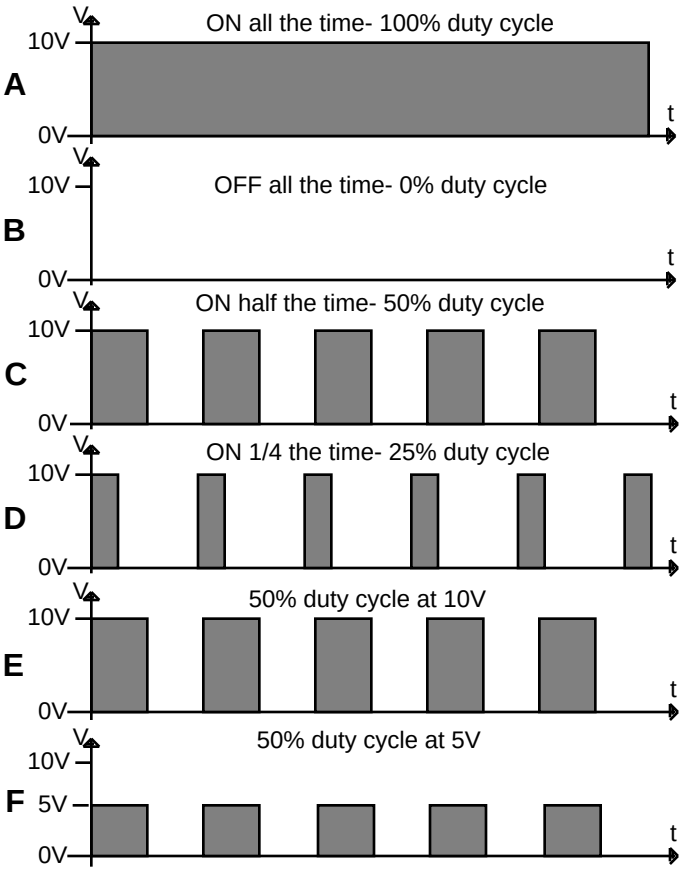


Fig. 1- The Power Content of Pulse Trains

This illustration is a graphical representation of the pulse situation. The vertical axis of the graphs represents voltage, while the horizontal axis represents time. The Section marked A shows the switch in the always ON, i.e. a duty cycle of 100%. The power of the pulse train is represented by the shaded area of the pulses. Section B illustrates the OFF condition, where there is no shaded area as the power is always OFF. Section C shows a pulse train of 50% duty cycle, i.e. the pulse is ON to the voltage level of 10 Volts for one half the time and OFF the remaining one half of the time. Section D illustrates the situation for a pulse train of 25% duty cycle. Sections E & F of Figure 1 show two pulse trains, each with a duty cycle of 50%. The pulse train in Section E has an amplitude of 10 Volts, while the pulses in Section F have an amplitude of 5 Volts. The shaded area in Section E is twice that in Section F, and the same is true for the power content of the respective pulse trains. The main idea to be gained from these illustrations is that power can be represented by the area under a curve, in this case the area under a series of rectangles. The secondary idea is that power can be controlled by time, by the duration over which the power is applied.

So why go to all this trouble?
One reason is efficiency. Consider the amount of power being consumed in Section C of Figure 1. This pulse train is transferring NO energy during its OFF time. The switch is completely shut off. The use of a resistor, as we discussed last month, involves continual loss as it always has electrons flowing through it. The pulse train enables us to control the energy flow without high loss.

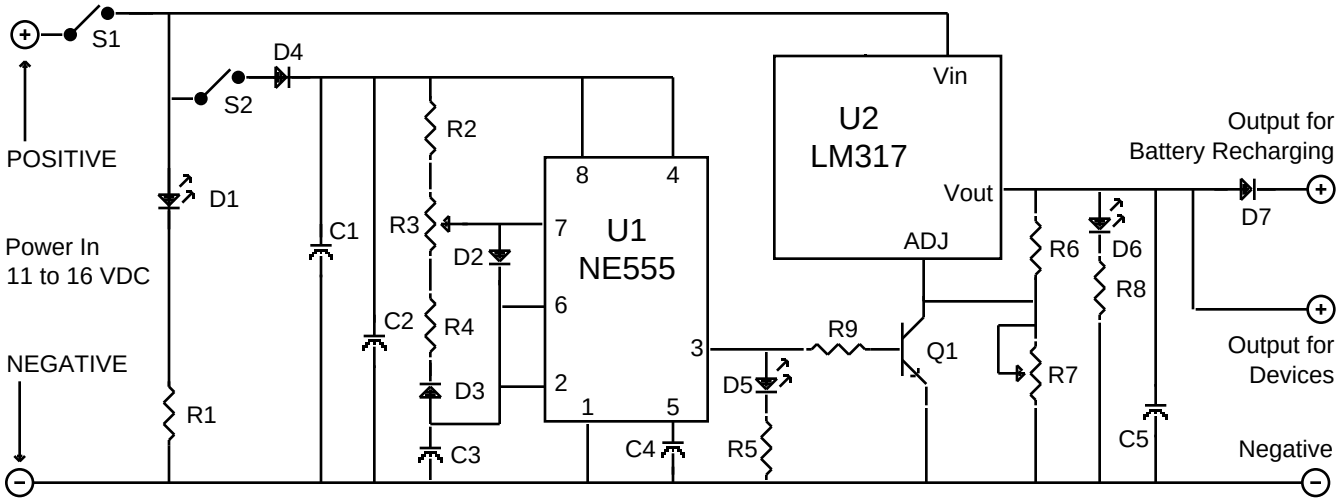
Pulse trains have added benefits when it comes to recharging nickel-cadmium batteries. The nicad has very low internal cell resistance. As such, it is possible to run very large amounts of current through the cell without damage, PROVIDED that the duty cycle of the pulses is small. The high current (and voltage) of the pulse zaps the interior of the cell into increased electrochemical activity. If this pulse train had a duty cycle of say 90%, it would overcharge and ruin the cell. But if we keep the duty cycle of the pulse train from around 5% to 40%, then we can have the benefits of high current recharging without the danger of cell damage.

I've been using pulse trains to recharge nicads since 1977. My personal experience is that a properly sized and applied pulse train can more than triple the life of expensive nickel-cadmium batteries. I've used pulses on AA, C, and D sized sintered plate nicads. By proper application of high current pulses, it is even possible to rejuvenate nicads suffering from dendrites. These dendrites are whiskers of nickel that grow within the cell as the cell ages. The dendrites may grow long enough to make a short circuit between the poles of the cell. The nicad then will no longer hold a charge as it discharges itself across the dendrites. The high current pulses employed in recharging can vaporize the ultra thin whiskers before they become substantial enough to ruin the cell.

Enter the Pulsar
We, at Electron Connection, decided to build a machine that would custom tailor pulse trains for the recharging of small nicad batteries. In 1983, we finally had a working model of what we call the -"Pulsar". This machine allows pulse trains of duty cycles between 5% and 95% to be generated at ON voltages from 1.2 VDC to 10 VDC (assuming 12 VDC as input power). The current output of the pulse train is 1.7 Amperes in one model, and 5 Amperes in the other. While the schematic may look complicated, the Pulsar is really very simple and many have been homemade hereabouts. Let's look at the schematic first.

The Pulsar uses two integrated circuits. U1 is a NE 555 electronic timer wired up as a variable duty cycle pulse train generator (a PWM really). U2 is an adjustable voltage regulator using either the LM 317 (1.7 Amps out) or the LM 350 (5 Amps out). The Pulsar accepts power input from 11 VDC to 16 VDC. Switch S1 turns on the unit, while switch S2 disables the pulse generator and makes the unit into a battery eliminator. With S2 open, the unit can make any DC voltage (not pulsed) between 1.2 and 10 VDC from a 12 VDC battery. It can directly power cassettes, radios, and other electronics than require 10 VDC or less to operate. With S2 closed, the pulsar is operational and the power output of U2 is a pulse train for recharging nicads or small lead acid gel cells. Note that there are two outputs, the one with the series diode is for battery recharging, while the one without the diode is for directly powering appliances with the pulse generator disabled (S2 open).
Resistor R3 is a potentiometer that controls the duty cycle of the pulse train. Resistor R7 controls the voltage (amplitude) of the pulse train, or the DC voltage if the unit is used as a battery eliminator.

NiCad Pulsar
Battery Charger & DC/DC Power Supply



Parts Listing

Integrated Circuits
U1- NE 555 Timer (8 pin DIP)
U2- LM 317 Adjustable Voltage Regulator (TO-220 or TO-3)

Transistors
Q1- 2N2222A NPN Silicon

Diodes
D1- Red LED
D2 & D3- 1N914
D4- 1N4001
D5- Yellow LED
D6- Green LED
D7- 3 Amp. Diode, heatsunk

Resistors (1/4 W. unless otherwise noted)
R1 & R5 & R9- 1 kΩ
R2 & R4- 2.2 kΩ
R3- 50 kΩ Potentiometer
R6- 240 Ω, 1/2 Watt
R7- 2 kΩ Potentiometer
R8- 500 Ω

Capacitors (25 VDC rated)
C1 & C3 & C4 & C5- .1 µf.
C2- 100 µf. Electrolytic

Switches
S1 & S2- SPST use >2 Amp rating

Fig.2 - The Pulsar's Schematic and Parts List

U2 is a very rugged device, being internally short circuit and overtemperature protected. The LM 317 is available in two different packages. The LM 317T has the smaller TO-220 case, while the LM 317K has the larger TO-3 case. In any case, the LM 317 must be heatsunk and the larger TO-3 case gets rid of heat better. While very much more expensive, the LM 350 gives the ability to move up to 5 Amps of current through the device.

Most of the parts can be purchased from Radio Shack. We encourage you to build your own. Or take the info to your local electronics head for help. Or completed models are available from Electron Connection Ltd., POB 442, Medford, OR 97501. The price is $140., completed with LM 317T. We make each one to order (on perfboard, no printed circuit boards yet), so please allow ten weeks for us to fill your order. Sorry no kits for the Pulsar yet. If many of you are interested, we'll do a rush on PC boards, so let us know.

Using Pulsars to recharge Nicads

In addition to the Pulsar, you will need the appropriate metering for information about the recharging process. A DMM with a shunt or ammeter is sufficient. To recharge a battery or a battery pack use the following procedure. 1) Turn the voltage control pot (R7) until the voltage is as high as possible. 2) Turn the amperage control (the duty cycle control- R3) to the minimum. 3) Connect the unit to the battery to be recharged via the diode (D7) output, and use an ammeter or shunt in this

line to measure the amount of current flowing into the battery. 4) Close S2. 5) Close S1- The unit is now operating and recharging the battery. 6) Adjust the amperage control (R3) until a C/10 rate is flowing into the battery. 7) If the batteries are completely empty, then leave them under charge for 15 hours & they'll be full.

The current that we are measuring is averaged out by the way that we are measuring it. Neither the DMM or the analog ammeter has the speed to measure the instantaneous amperage output of the pulse. What we see on the meter is a time averaged version. This is also how the nicad cell sees the pulse, as an average charge current. For example, if our meter shows 0.1 Amps as the charge rate, and the duty cycle is say, 10%, then the instantaneous amperage of the pulse is about 1 ampere. While the instantaneous amperage is very high, the average is within the operational range for recharging the cell. So just use any old ammeter and set the recharging current for the C/10 rate for that particular cell or pack. If you are recharging very small capacity nicads and are unable to get the current low enough via the amperage control (R3), then reduce the voltage control (R7) until you get a C/10 rate.

Using the DC/DC Converter

If S2 is left open, then the Pulsar operates as a straight DC regulator; its output is smooth DC rather than a pulse train. Consider all the small electronic devices we use that employ internal batteries. In DC mode, the Pulsar can power your Walkman, Stereo, Radio, or WhatHaveYou directly from your larger 12 VDC battery system. This is really an added benefit, all that is required is the addition of one switch (S2), and the device becomes dual purpose. It recharges batteries and it directly powers devices without using their internal batteries.

To use the Pulsar as a DC/DC converter simply open S2 (disabling the pulse generator) and adjust the voltage you require on R7. Use the output bypassing D7 for greater efficiency.

Amateur Radio

Brian Green N6HWY

In this day and age, communication is essential. Amateur radio is an excellent means of sharing information about home power as well as providing reliable outback communications. Amateur radio is a government licensed radio service for personal use. All forms of two way radio transmission are allowed on a very wide range of frequencies. Amateur radio operators (called Hams, no one knows why…) run everything from 2 way Television to Morse Code to computerized packet radio. And they talk everywhere, from across the world to down the street.

A Short History of Hams

In the beginning, before military or commercial radio, all radio was amateur radio. Starting at the turn of the century intrepid electrical experimenters began duplicating the work of Marconi and others. In January of 1909, the first radio club was formed. It was called "The Junior Wireless Club Ltd. of New York City". Its five founders averaged 12 years of age. By 1910 there were an estimated 4,000 amateur radio stations on the air. In 1912 laws were passed giving amateurs the 200 meter (1500 kHz) radio band. Consider that the 200 meter band is in what we now know as the AM broadcast band. At that time, both commercial and military radio interests considered the 200 meter band to be useless because it was too high in frequency. Thus began the Hams' search in innovative radio; they have always been pioneers.

During both World Wars, large numbers of Ham operators served as radio operators in the military. Other hams developed advanced communication techniques and equipment for both military and commercial use. Much of the communications technology we now use can be traced back to a Ham nerding in his shack saying, "What if?". If you're interested in more Ham history, please read 200 Meters and Down by C. DeSoto (1936, 1987).

Hams Today

There isn't any shortage of variety in Ham radio. Hams communicate using everything from Morse Code to computerized data transmission on their very own satellite system. Hams operate on so many bands and with so many different types of transmissions that the possibilities are endless. Hams are licensed for Morse Code (that's dit, dah), voice transmission in AM, FM and SSB (Single SideBand) modes, TV transmission, and many forms of digital tranmissions. The radio bands, or frequencies, licensed to the Hams allow communication with just about any place on Earth. Why Hams even bounce their radio signals off the Moon and back to Earth.

Community services are high on the Ham's list of priorities. These community services range from just helping out local organizations with communication, to life and death emergency service. For example, last week in Yreka CA communications were provided for the local Lions Club bike-a-thon by Hams. Last year, Hams provided communications for fire teams fighting the massive forrest fires on the West Coast. I remember spending hours listening to Hams handle emergency traffic for the Alaska earthquake in 1964. The list goes endlessly on…

Probably the most popular Ham activity is "Rag Chewing". Hams chew the rag on any band, at any time, and to anywhere. One of the most popular Ham bands, and one entirely suited to homestead communications, is the 2 meter band (144 to 148 MHz). Two meters is one of the most well organized and versatile of the Ham bands. Most areas abound with "repeaters" that work on the 2 meter band. A repeater receives and rebroadcasts radio signals for greater range. Some of these repeaters are interfaced with the telephone network and local nonbusiness telephone calls are permitted on them. The ultimate in repeaters is OSCAR (Orbiting Satellite Carrying Amateur Radio). OSCAR was built by Hams and launched into Earth orbit by the U.S. government. OSCAR is used by Hams all over the world, and is a bridge to international communication and understanding.

The Rules of Ham Radio

Ham radio is basically a hobby type service. Any sort of business activity is not permitted. The operator of a Ham radio station must hold a valid operators license in order to legally operate that station. Within these limitations, there is a whole world of communication offered to those of us beyond the telephone lines. Ham radio can provide the essential communication to keep us back country folks in touch with friends and family. It's also nice to know that emergency assistance can be summoned to remote locations via the helpful Hams. Ham radio also puts us in touch with an international network of technically adept people. Topics such as PV power and battery storage are everyday rag chew subjects.

Getting Started in Ham Radio

Yes, you must learn Morse code. Morse code is required by international radio law and treaty. Learning Morse code is really not that difficult. The minimum Morse code requirement, for a Novice Amateur Radio license, is 5 WPM (Words Per Minute). Five WPM, along with a 30 question, multiple choice, test on elementary radio theory and FCC rules gives you a Novice ticket. Under new FCC rules, novices now have voice privileges on the 1.25 meter (220 MHz) band and the 10 meter (28 MHz) band. The 1.25 meter band is very effective for local communication within a 40 to 100 mile radius. There are many repeaters on the 1.25 meter band already. The 10 meter band is suitable for global communication, and novices talk to stations from Tennessee to Timbucktoo.

The next higher level of Amateur radio license is the Technician grade. This requires a slightly harder written exam and no additional Morse code. The technician ticket gives full operating privileges on all bands higher than 50 MHz, including the very useful 2 meter band.

Getting Help
Hams like to show off their radio shacks, just like most of us like to show off our home power systems. Getting started won't be any problem because Hams are everywhere. Look around for large antenna arrays (TV antennas with a gland problem), ring the bell and ask. Hams are communicators and they will help you get in touch with the local ham radio club or repeater association. These clubs are a good place to join a Novice class or get more information.

If you can't locate a Ham by his antennas, then contact the ARRL (American Radio Relay League). The ARRL can put you in touch with your local Ham radio club and its classes. Write the ARRL at 225 Main St., Newington, CT 06111. A beginners package called, "Tune in the World with Ham Radio" is available form the ARRL. Many of us have become Hams with just such a package and no formalized classroom instruction. It's really not hard. Study material is also available from other sources. Radio Shack has a Novice study course (RS part # 62-2402) for $19.95. Heathkit, POB 1288, Benton Harbor, MI 49022, offers several Ham radio instruction courses. Heathkits' #ER-3701 Ham course costs $44.95. Heathkit Ham courses are available for computer aided instruction, are very well written, and come with a money back guarantee. If you don't pass your Ham exam, you get your money for the course back.

Gordon West Radio School offers Ham radio license instruction courses. Gordon has a wide variety of material from Novice to Extra class. I just received his "21 Day Novice Code & Theory Course" (Course #04) for $19.95. It includes two Morse code instruction cassette tapes, a theory & FCC regulations book, and other stuff including rebate coupons for ham equipment. I am testing this kit on local would be novices and will let you know how it works. It looks very complete. You can write the Gordon West Radio School at 2414 College Dr., Cosa Mesa, CA 92626 or telephone 714-549-5000. Richard Measures' columns on basic electricity in Home Power is part of the theory you will need to get your Ham ticket. Here we have a no lose situation--Ham radio and home power share much of the same electronic theory. What you learn in one will help you with the other.

Is Ham Radio Expensive?
No, a VHF voice station can cost as little as $300 and spans a radius over 60 miles. An internationally talking HF Ham station will cost about $950 to set up. Most all ham gear is powered directly by 12 VDC and is a natural for operation on our home power battery packs. Used gear is much cheaper and sold at your local club's swap meets.

Home Power & Ham Radio
Several Hams have asked about starting a Home Power net. Let's give it a try on 40 meters. I'll transmit a CQ "Home Power" somewhere between 7.230 and 7.250 MHz. on June 19 and June 26 at 2330 UTC (4:30 PM PDT). At this time and frequency, I expect that we will cover the Western US and as the band goes long pick up the rest of the USA.

If you are a Ham and are interested in a net about home power stuff, please write me at 13109 Norman Dr., Montague, CA 96064. I'm compiling a list of Hams and if there is enough interest we'll publish this list so everyone can get together. Please include info about your operating frequencies & times.

I encourage you to share your communications experiences with all the readers of Home Power. So, HELP! When I'm not playing in little boats on Monterey Bay I'm allowing this writing business to scare the hell out of me. Energy not shared is Energy lost. 73s.

Things that Work!

tests conducted by the Home Power Crew

Many of you have written for information about efficient, 12 VDC powered, refrigeration. Well, here's a test of Sun Frost's super-efficient RF-12, a 12 cubic foot refrigerator/freezer. It can be powered with only two 48 Watt PV modules.

Shipping Container & Documentation
The Sun Frost unit arrived from Arcata, California via motor freight in fine shape. It was well packaged, and the actual refrigerator was screwed to a wooden pallet. Complete, written, uncrating instruction were provided by Sun Frost. According to the shipping company, the refrigerator/freezer, its packing and pallet weighed 230 pounds.

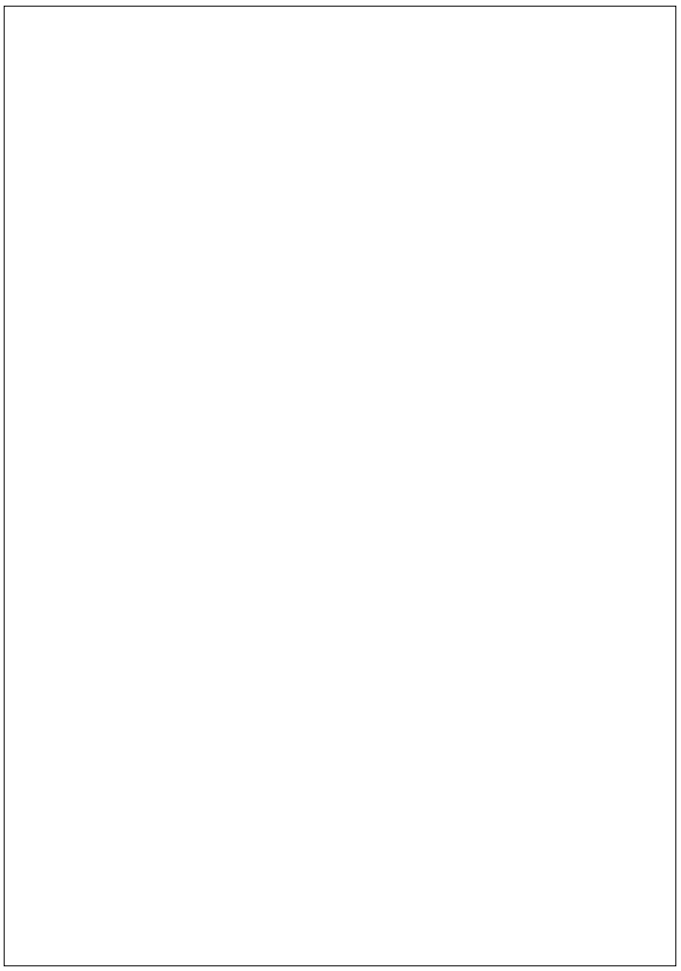
The installation and operating manual is complete, with sections on food storage techniques, defrosting, door adjustment and troubleshooting. We had no trouble installing and operating the unit from the info provided in its manual. Sun Frost also provides a form for our feedback, complete with stamped envelope. It's nice to see they care about how we feel about their products.

Physical Examination
First of all, this is the biggest 12 cubic foot refrigerator/freezer we've ever seen. Outside dimensions of the entire unit are 34.5 inches wide by 27.75 inches deep by 49.25 inches high. The inside dimensions of refrigerator compartment are 28 inches wide by 20.5 inches deep by 24 inches high. The inside dimensions of freezer compartment are 26 inches wide by 21 inches deep by 6.5 inches high. If you compare the outside dimensions of the unit to its inside dimensions, then the amount of insulation provided in the Sun Frost is obvious. There is about 3 inches of polyurethane foam insulation surrounding the refrigerator section and about 4.5 inches around the freezer. According to Sun Frost, there are no metal supports between the inside and the outside of the unit. This further insulates the compartments by eliminating heat transfer through metal supports.

The outside finish of the Sun Frost is superb. The RF-12 we tested was colored white in a flawless matte finish. The compressor (a Danfoss unit using a brushless DC motor), condenser, and all controls, are mounted on the top of the RF-12. This is done for better heat dissipation and easier cleaning of the condenser. The massive doors (both the refrigerator and the freezer have their own individual doors) are mounted on piano style hinges and close securely to the box with adjustable catches. The fit on the doors is very tight.

The refrigerator compartment is equipped with three adjustable glass shelves, a light, and copious amounts of bottle storage in the door. All the inside surfaces are easy to clean, slick white fiberglass. The freezer compartment is unstructured and contains no racks or shelves.

Installation & Test System
On 23 April 1988 we installed the Sun Frost in John & Anita Pryor's system (see Home Power #2). This system consists of 4 Trojan L-16Ws (700 Ampere-hours at 12 VDC), 4 Kyocera 48 Watt PV modules, a 1.5 Trace inverter/charger, and a gas/12 VDC alternator backup. John and Anita were kind enough to let us set up the unit in their living room where the ambient temperature is kept at about 68°F. most of the time. During the test period John & Anita used the Sun Frost in place of their regular refrigerator. They used it normally, opening the doors whenever necessary to remove or add food to the unit.



We wired the Sun Frost to the batteries with about 16 feet of #10 gauge copper wire. We also installed an hour meter to keep track of the amount of time that the unit's motor was actually running. We measured the electrical parameters of the unit with a 3468A Hewlett Packard DMM and a Fluke 77 DMM. We placed thermometers in the compartments, along with all John and Anita's refrigerated food.

Operation of the Sun Frost

We turned the thermostat to the manufacturer's recommended setting of 38°F. in the refrigerator section. The Sun Frost started immediately and took about 2.7 hours to pump the refrigerator compartment down to 38°F. At this time the freezer compartment's temperature was measured at 7°F. The first thing we noticed about the unit was how quiet it was. This is the quietest electric refrigerator that we've ever heard. About the only noticeable noise was an occasional soft gurgle as the Freon R-12 refrigerant circulated.

The thermostat setting tracked exactly with our interior thermometer. The Sun Frost's thermostat is actually calibrated in degrees. Compare this with other units that offer a 1 to 10 type of calibration.

Voltage levels in the system ranged from 11.8 to 15.2 VDC during the test period. Sun Frost rates the RF-12 for operation anywhere in the 11 to 15.5 VDC range. 24 VDC models are also available.

Average current consumption of the RF-12 was 4.4 Amperes while running. Current consumption of this unit was 4.8 Amperes at 12.4 VDC after startup, with an initial startup surge of 14.6 Amperes. As the box cooled, the current consumption dropped and the motor's running current consumption averaged 4.4 Amperes during the test period.

John and Anita continued using the unit until 10 May 1988. The duration of the test was 16.5 days or a total of 396 hours. The hour meter measured the operation of the Sun Frost's motor for 84.2 hours during the test period. This calculates to an average "ON" time of 21% or 5.1 hours daily.

The 12 cubic foot Sun Frost refrigerator/freezer consumed an average of 22.45 Ampere-hours, or 277 Watt-hours, per day during this test. Sun Frost rates the RF-12's consumption at 28 Ampere-hours per day in a 70°F. ambient temperature environment. What this really means is that, in most locations, two 48 Watt PV modules produce enough energy daily to run this Sun Frost refrigerator freezer combo. In fact, according to our test there will be energy left over from two PV modules (assuming a module produces at least 16 Ampere-hours per day).

Cost

The list price of the RF-12 Sun Frost is $1560, plus $50 for a crating charge, FOB Arcata CA. If the cost of powering the unit over a ten year period is considered then an additional $1,250 will be spent on energy at about $1.00 per kiloWatt-hour (a strictly ballpark average cost for home power systems). The total cost of buying and powering the RF-12 will be about $2,800 over a ten year period. This includes the refrigerator itself, the PVs to power it, and the batteries needed to support the refrigerator.

An efficient type of household refrigerator will consume about 1,500 Watt-hours per day. This consumption is according to the US Department of Energy. If this refrigerator were to cost say $600, and we consider the cost of the equipment to power it (about $5,500 at $1.00 per kiloWatt-hour), then the total refrigeration cost is about $6,100 over a ten year period. Compare this to the $2,800 above and you'll see that eventhough the Sun Frost RF-12 is initially more expensive than conventional refrigerators, it is actually much cheaper to both buy and operate.

The reason for this is energy consumption. The conventional refrigerator will require about 8 PV panels to supply its power, and additional batteries to support it during cloudy periods. As in most home power situations, it's not the cost of the appliance that really counts, but the cost of the energy it consumes.

Conclusion

The Sun Frost RF-12 is an extremely well made and ultra-efficient refrigerator freezer. It runs directly on 12 VDC (there are also 24 VDC models), thus bypassing the necessity and power loss of an inverter. Existing PV/battery systems can add the Sun Frost RF-12 and power it by adding only 2 PV modules. This refrigerator is truly a "Thing that Works!". It is designed for us Watt-watching, home power, folks. Larry Schlussler and the Crew at Sun Frost are making a truly amazing machine.

If the cost of powering the refrigeration equipment is added to its purchase price, then the Sun Frost RF-12 is about half the cost of running conventional, high-efficiency refrigeration in home power systems. We like this refrigerator and are saving up so one can come to live in our kitchen.

You can write Sun Frost for more information at POB 1101, Arcata, CA 95521 or telephone 707-822-9095. The RF-12 is only one model in their extensive line which offers larger, smaller, and freezer only units.

Reading & Using an Electrical Diagram to Solve Problems

Richard Measures

Reading an electrical diagram is like reading a roadmap. On a roadmap the lines indicate roadways. On an electrical (schematic) diagram the lines indicate wires which are roadways for electrons. On a roadmap symbols are used to indicate bridges, schools, airports, tunnels parking-lots and the like. On a schematic diagram symbols indicate resistors, lamps, motors, batteries, switches, transistors and other related items. Once you become familiar with the electrical symbols, reading a schematic diagram is not any more difficult than reading a roadmap.

Look over the drawing of the commonly used symbols (next page). Most of these symbols are somewhat logical. To me, the only exception is the resistor symbol. It does not resemble a resistor but it is very distinctive and this helps to keep it from being confused with the other symbols.

On Schematic Diagram A there is a drawing that represents an electrical circuit for a heater (resistor) controlled by a switch; a 10 volt battery; a 6 volt incandescent lamp with a series resistor and switch plus another heater-resistor - except that this one is controlled automatically by a thermal-switch such as would be used in cold climates to keep water pipes from freezing. This switch will open at 2°C so that whenever the temperature is more than 2°C. above freezing, the switch will open and stop the flow of current through the heater-resistor. When the temperature falls below 2°C. the switch closes and the heater-resistor will draw current and dissipate heat into the pipes.

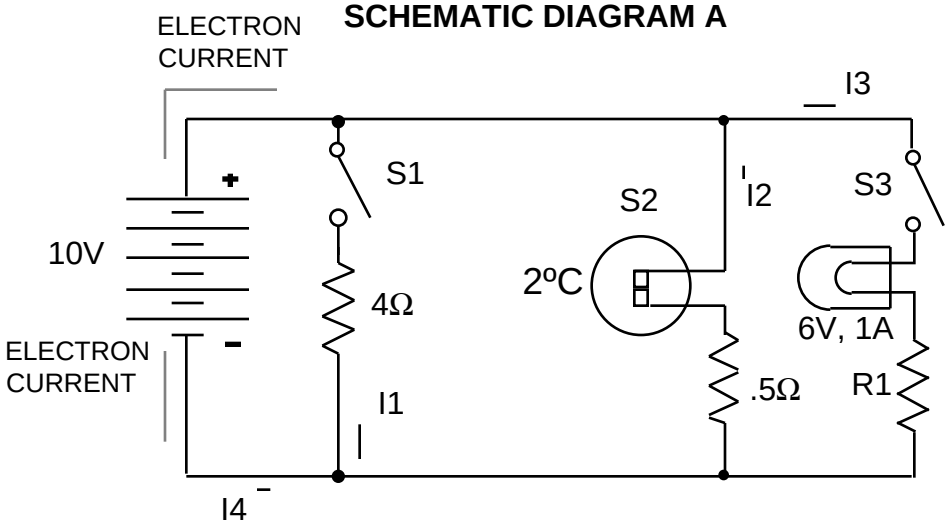
Here are some questions about Schematic Diagram A:

1. How much current (I1) flows through the 4Ω resistor when S1 is closed ?
2. If the lamp shown is rated at 6V, 1A, how many ohms is needed for R1?
3. Find I2 when the ambient temperature is 0°C and also the power dissipated by the .5Ω resistor.
4. Find I3, and I4 when the ambient temperature is 25°C, S1 is closed and S3 is open.
5. What is the largest possible current that could be drawn from the battery?

Solutions:

1. Using I=E/R: I1=10V/4Ω = 2.5A.
2. The lamp needs 6V. The battery provides 10V which is 4V

SCHEMATIC DIAGRAM A



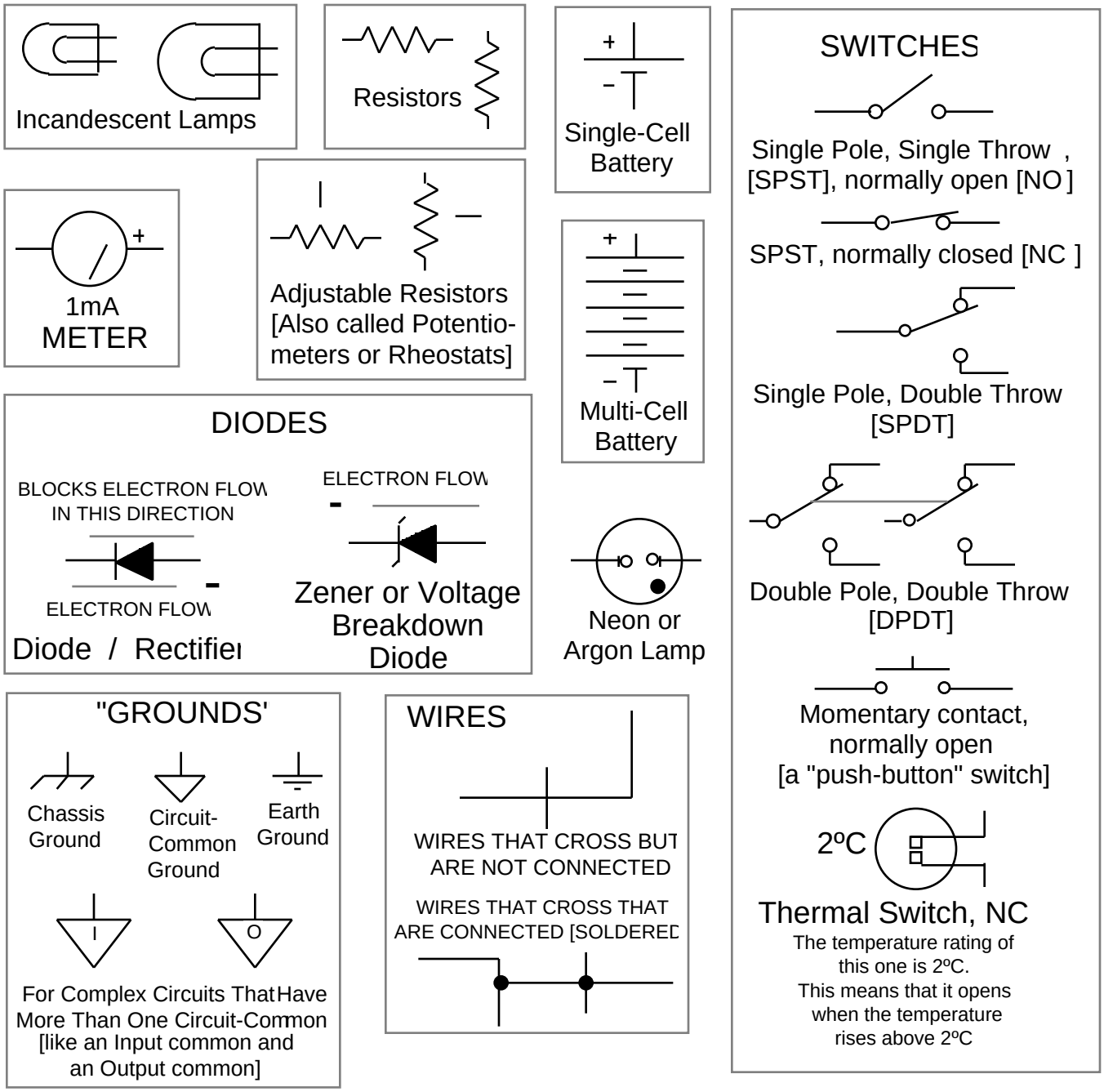
too much. So 4V must be wasted in R1. The current that flows in R1 is the same as current in the lamp: 1A. Using R=E/I: R1=4V/1A = 4Ω.

3. The thermal-switch will be closed at 0°C. So current will be flowing in the .5Ω resistor. Using I=E/R: I2=10V/.5Ω = 20A. The power dissipated can be found by using P=IE: P=20A x 10V = 200 watts.

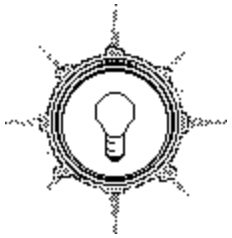
4. If S3 is open then I3 must be zero. At 25°C, S2 is also open so I2 is also zero. The only current that can flow must pass through S1 which was previously found to be 2.5A.

5. If S1, S2, and S3 were all closed, the total current would be 2.5A + 20A + 1A = 23.5A

Commonly Used Symbols On Schematic Diagrams



Home Power's Business



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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.
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See other Mercantile suggestions on page 48.

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These ads are designed for individuals rather than companies. So use your discretion. The rates are 5¢ per character, including spaces & punctuation.

" I didn't tell him about the giant bats, I figured he'd see them soon enough…"

Hunter S. Thompson

Letters to Home Power

Letters printed unedited. We'll print your name & address if you say it's OK.
Compiled by Karen Perez

Dear Home Power People: We have gone through the first 3 issues of your Home Power Magazine, not only once but several times and find them chock full of the type of information that people such as us are really hungry for. It is the best we have seen since John Shuttleworth's Mother Earth Magazine of which we have a full library from day one. It is like Mr. Shuttleworth says in his letter, "Mother Earth is pretty dopey nowadays".

In 1978 my wife and I set out to develop this 9 acres of land we own on top of a mountain here in Vermont, to be as near as possible, self-sufficient by the time we retire. We have constructed a 65 foot tower on top of which we have put a 450 watt, 12 volt DC windmill. Also we have built, as a back-up charging unit, a 12 volt DC alternator, designed our own control panel that feeds 2 separate battery packs. We also have a commercial built AC generator which we start up approximately once a week to do our washing, vacuuming, etc. We hope very soon to add solar panels for charging these batteries also. We have pure mountain spring water, gravity fed into our home. We also built our own compost toilet and garbage disposal. We heat our place with firewood cut from our own land, in a stove we built from 2 oil barrels which utilizes a catalytic combustor. We have set out fruit and nut trees, a variety of berries, grapes and of course we grow our own garden for vegetables. Any project requiring lumber we saw from our own stand of spruce with a portable sawmill, about any dimensions we desire. Too numerous to mention or itemize are many other projects either completed or in the process or in the planning stages. My wife and I have accomplished this by ourselves with the help of an old 1963 John Deere crawler and loader which we purchased some years back.

Now we find ourselves, ten years later, in our late fifties and by ourselves doing this thing. We fear we will be unable or will not have time to complete all the potential that we can see for this goal. The solar alone which we have not even scratched the surface of, has great potential as we have excellent southern exposure, winter and summer, also we have the possibility of hydro which we have not scratched the surface of.

What this all boils down to is perhaps there might be another younger couple out there that would be compatible to us and our ideas and lifestyle etc. that might be interested in investing in this lifestyle and working with us on a perpetual basis. In other words, working and investing towards these goals we have set and helping us through the rest of our lives accomplishing and living these goals and eventually ending up with everything themselves to go on with whatever should come.

Perhaps you could print this letter in your magazine either as written or in condensed form and perhaps by doing so you could put us in touch with the right people. We would be interested in corresponding with any couple that would be sincere in this type of life style. Perhaps nothing would ever come of it but we thought it might be worth a try. We know no couples personally that really would be sincere in this type of living.

In closing we would like to say to you Home Power people, please keep up the good work and keep the issues coming. Please find enclosed a small contribution in the form of a check to help you on your way. Good Luck & God Bless.

Harry & Grace Cole
HCR 70, Box 73
Bridgewater Corners, VT 05035

Dear Home Power Friends: I wanted to drop you a note to let you know how much I have enjoyed your magazine. I'm sending you a list of a couple of my friends who I'd like to receive your magazine so that my copy doesn't have to travel so many miles each month from house to house before I can get a good look at it!

I'm an amateur (Ham) radio operator and I would like to see if other Ham operators who enjoy alternative energy would like to meet on the airwaves to discuss the topic. If you would like to publish the following information it would be very helpful.

Jim Minton, POB 190121, Anchorage, AK 99519 .
Radio Call: KL7JIJ Monitor Frequency: 14.292 MHz.

Dear Home Power Folks: A friend of mine has sent to me the first three issues of your Home Power Magazine. I have to say they contain the most informative and knowledgeable articles on A.E. I have seen so far. Keep up the good work!

Enclosed please find a M.O. for $21.00 in U.S. funds for a subscription. From what I have seen in your first three issues this is a bargin.

We live at mile 143 on the Alaska Hiway in Northern British Columbia, Canada and this is only 500 miles from the Artic Circle. At this latitude we have only 5 hours of sunlight per day in mid-winter, but in mid-summer we experience 18 hours of sunlight per day. We have been using PV power on our cattle ranch for 2 years and have found the solution to our power needs. Except for the months of Dec. & Jan., when we use our gen set once a week for charging, PV has provided all our power needs. To do this we adhear to strict power management practices that we have set for ourselves.

Our system consists of an 8 panel array of 45 watt Kyocera modules, a BOSS 30A controler, Magnacharge 1200AH deep cycle battery bank, 1500W and 600W Trace inverters. Our only problem now is finding a tracker which will work in this climate where winter temperatures reach -40°F and lower. At present we have our array on a ground based swivel arrangement that we turn & lock manually, periodically through out the day. If you or any of your readers have an answer for this problem we would appreciate hearing from you. Perhaps an article in your magazine on tracking in general would help me and others with different problems encountered.

Our lights, water pump, fans, stereo, deep freeze and radio telephone are 12V. Our power tools, appliances, satellite reciever, 20" color TV, washer, dryer, and vaccum are all run by the Trace inverters. To date we have had no problems with any of the system components. The inverters, controller and batteries are all enclosed in one room inside our house, with the batteries vented to the outside.

The British Columbia Government has recently installed (March 17/88) AH meters on our system to monitor cumulative data on charging and load usage. This project is to run for 9 months and ends Dec. 31, 1988. We record the meter readings daily along with weather conditions and any extra ordinary usage out of the norm. They are monitoring various systems throughtout the Province in the same way.

There are thousands of motor driven generators in use all across Northern Canada as power grids are few and far between. The government is looking to other sources of power generation, to eliminate the use of fossil fuels as much as

possible.

After the project is finshed and the data correlated, and if it is found to be of a positive nature, the Government plans to hold seminars around the Province to educate and encourage the use of photovoltaics. Tax incentives and grants or low interest loans may be in order to help and encourage people to buy PV systems. If the other systems being monitored in this project work as well for their owners as ours has for us, these incentives may soon become a reality.

Bob McCormick
POB 14
Pink Mountain, B.C., Canada V0C 2B0

I've been searching, with few results, for information and reading AE, especially Photovoltaics. And now a grandiose dose all at once. I've learned more in the last 5 minutes, than in the last 5 weeks. I'll be in contact with many of your advertisers. It's as though a whole new world has opened up. Thank You, Leif Juell, Bethel, VT

Congratulations on a great idea for a magazine! I am now employed by electric utility and realize the inevitability of home power. I am proud to say that the utility understands this also and is working to promote renewables for the benefit of everyone. Let's keep working together! Dave Panico, Austin, TX

Dear Wizard: Hopefully, my forty odd years of work with electricity does not disqualify my philosophical distractions.

Your "three big pigs" commentary hit pretty close to the target. But your promise of a "free lunch" is trapped in the jaws of reality.

Nature dictates that the mother makes a sacrifice to bring new life into the world. To paraphrase an ancient line: In everything you do, observe the workings of Nature. This can do much to encourage your success.

In electricity, the word "generate" conveys a false impression. Energy conversion is the real process. We do not create energy any more than government creates wealth with the printing press and entries in it's debt ledger. We borrow from tomorrow.

Unless you can enslave the Martians or con them into doing the conversion for us, it is not likely that perpetual motion will ever be more than a figment of vaporous imagination.

Obviously, such natural restrictions should not be viewed as excuse to halt the search for more efficient and more environmentally acceptable methods of energy conversion. But until those restrictions are lifted by the Spirit forces that set the sun in orbit and decreed the law of Ohm, we are stuck with less than 100% in our energy conversion process.

In humble recognition of you august powers I remain the Prairie Prophet.

Nature lays many traps for the unwary, but continually brews new potions for her devotees. We but aspire to her hidden mysteries and hope to tap her as yet unrealized energies. Thanks Prairie Prophet. The Wiz.

Thanks for publishing such a useful magazine. There is a group of families living here in Western NC using PV electricity and I thought our experience might be useful for others.

Seven households in or near the Celo Community Land Trust are using PV's exclusively for electricity. Most of the houses are also passive solar for heat with wood backup. Most are using LPG for refrigeration and cooking. Commercial power is readily available here so the decision to go with PV's has been made for reasons ranging from a desire for independence, concern with the environment, to not wanting a 60 ft. wide corridor cut for power line access.

We have been able to make some purchases as a group (panels, batteries) and thereby saved some on cost. We have also been able to share experience and skills which has made system installation easier. The table below gives details of the systems which vary widely in size and sophistication. Western NC is hardly ideal in terms of insolation, but except for late Nov

PV PWR-- Panel rating in watts; most are single crystal, some Kyocera multicrystaline.

BAT-- rated battery storage in amp-hrs; most are GBC-220 6V electric vehicle batteries.

YRS--years of use.

ACCESSORIES--1) charge controller 2) inverter 3) tracker.

REFRIGERATION-- number in ( ) is year of manufacture; Sunfrost is on order and will be powered with additional panels.

USES--1) water pump 2) AC tools 3) computer 4) clothes washer 5) lights 6) radio/sound/TV equipment 7) refrigeration/freezer.

All DC systems are 12V. The 2 inverters are HEART H12-1000 watt; the tracker is a SUN SEEKER (Robbins Engineering) freon driven on a home made stand and has worked flawlessly for 3 years. Water pumps are FLOJET except for one microsubmersible deep well pump from Wind Light Workshop (Flowlight Solar). The clothes washer is Sears Model 11451, a front loader using 800 watts max, 400 during most of the cycle and less than 12 gallons of water. The computer is a 12MHz 286 with 44 MB HD using an LCD backlit screen and requires about 60 watts.

Most houses are fully wired using #10 for the 12V. The Eagle 829B socket is used in some installations. This socket has one 120V standard vertical prong socket and one horizontal prong 220V socket. I use the 220V for 12V DC and the 120V for the inverted AC.

Household	PV Pwr	Bat	Yrs	Access.	Refrigerator	Uses
Hoover	240	660	4	1,2,3	Servel (35)	1,2,3,4,5,6
Engman	60	440	3	1	Norcold	1,5,6
Wyatt	120	440	new	--	Servel (30)	1,5,6
Blood/Green	150	440	1	--	--	5,6
Hollis/Orm'd	180	440	2	--	Sibir	5,6
Pertee	120	440	new	1,2	Sibir	2,3,5,6
Kent	70	440	1	--	(SunFrost)	1,5,6,7

One household has a backup 3000 watt AC generator charging through a 60 amp charger, one has a 30 amp auto generator attached (in winter) to a rototiller. The others use no backup.

We would be interested in communicating with other people using home power in the area. Please write care of:

Paul S. Hoover
461 Hannah Br. Road
Burnsville, NC 28714.

Letters to Home Power

I am writing this letter to alert folks to a new book called "ChemCom, Chemistry in the Community", 1988. This book is published by Kendall/Hunt of Dubuque, Iowa, and is authored by the American Chemical Society. It has had earlier editions in 1980 and 1985 as pilot programs. At first glance I thought this was a neat idea. The problem is that they seem to have left out clean power in favor of nuclear power as a solution to our power needs. When I questioned their representative about this, he said that it was no problem-- the students would come up with ideas like solar and wind. (This can be used as a classroom text.) It seems to me that omission would indicate a lack of importance.

In Unit Three, "Petroleum: To Build or Burn?" section 3, "Alternatives to Petroleum", the opening page shows a nuclear cooling tower. Unit five, "Nuclear Chemistry in Our World", further promotes nuclear energy. Ideas about photovoltaics and/or wind are vaguely mentioned or not mentioned at all.

If this concerns you as much as it does me, you might want to check to see if your school is using this book. I have not yet taken time to study it to see if the bias toward earth exploitation is found throughout the book. I would like to think that the ideas in this book might move the next generation in a positive direction. I feel it is a shame that methane and photovoltaics, which are power sources related to the study of chemistry, were not treated fairly.

Ronald Solberg
RR#2 Box 149
Hills, MN, 56138

I am sitting, drinking my morning coffee, listening to a local community owned radio station not plugged into the National Network (commercial free), reading through issue #4 of Home Power, another unplugged outlet.

We live in a house that works. Even though the temperatures fall below zero (F°) consistently for two months each winter (at times the high is below zero) our wood consumption is below two cords per winter. Our greenhouses provide winter greenery and greens for eating, right in our kitchen. A hand pump provides water directly into the kitchen sink. Two Solarex, 3 amp panels charge a Sears commercial battery. The panels were unframed #1 quality purchased for $180.00 each plus $30.00 shipping. The battery was $75.00. Each of the 2 bedrooms has a 15 watt fluorescent light while the kitchen has a unit with (2) 8 watt tubes over the working area as does the desk/library area. A JVC DC-7 provides excellent sound on all radio bands (including short wave 16M to 120M), a stereo cassette & a linear tracking turntable. At full volume (which is never done) this unit consumes 1 amp @ 12 volts.

Our gardens provide most of our food (no, we don't grow coffee). A root cellar is built into the kitchen and keeps whatever cool (even beer stays around 42°-45°F). We don't keep meat products so nothing spoils.

We don't have word processors or computers, we prefer doing a lot of things by hand. There is a real zen-ness about chopping wood, pumping water & doing minimal laundry needs. Cooking is a family affair as is bathing in the sauna, which is the Heart of the house. We live near the headwaters of the Mississippi River where the water is pure, the air clean & the land is cheap. Wildlife is abundant- that includes some group get togethers. We don't have bills so we don't need to travel to a town to work at a job we don't like or agree with. We make enough money to live our simple life-style. This past winter a friend stayed in our home while we traveled in Mexico - Again, it wasn't costly. We crossed the border going South with $600.00 US funds. That kept Nancy, Dylan (our son), Be-Bop (our dog), & me all happy for the winter.

I guess my point in bringing all this up is: The simpler we live the fuller our lives become.

Imagine yourself naked in the woods, What do you need? Well, nothing if it's warm. If it rains, you need shelter. If it snows, you need heat. If company comes, you may need clothes. If your hungry - food. Thirsty - water. If we can approach our needs & insert a FEW wants it's quite easy to live without hurting the earth, while allowing our co-habitants of this paradise planet to have their needs met, as well.

When alternative energy is discussed it is often approached from the opposite direction. "Lessee - what will I have to do without".

I also wanted to comment on John Shuttleworth's letter. Yeah, things are bleak and it's getting late - but let's not give up. The best way to teach is by example, and when your own house is in order it gives you more ways to convince others.

Peace to all you warriors of the Rainbow.

Bruce Brummitt
POB 252, Osage, MN 56570

P.S. Anyone interested in cheap land & simple lifestyles are welcome to write.

Richard Perez's article on radio telephones was excellent and parallels our experiences. But there is another alternative. The FCC has several narrow slots of frequencies that are alloted for radiophones. Our solar powered 12VDC equipment is in the 30 MHz band which is just above the CB frequencies. A number of things can determine which frequency to use but in general if your terrain is flat, use the higher frequencies; if mountainous use the lower frequencies. Our home is on a small island about 20 miles from Kodiak and the signals have to pass over (or bounce around) 2 ridges of mountains.

R. Perez's description of simplex was accurate. Though we do not find the problem he does, and run two small businesses from our island. We find it easy to instruct the phone party that our equipment has an audio beep when we release the PTT key and that this is their signal that they can talk. The equipment consists of two radiophones and a computer that interfaces the phone line and the radio in town. The computer has 67 functions that are controlled from the touch tone pad on our home radio.

The advantages: The FCC allows up to 100 watts on the phones. This is 4 times what is allowed to CB and VHF. You own (cost comparable to Perez's quotes for IMTS service) all the equipment. Therefore once the up front costs are paid your monthly phone bill is identical to someone in town. There are no call time limits, no increasing costs with length of calls and no charges in the future.

Another important note on radio installations. Be sure your wiring will deliver the voltage required when transmitting. A one volt drop when you key the transmitter reduces the signal output by 50%.

Send an SASE and I'll try to answer questions.

Walt Cunningham
Bare Island
Port Bailey, Alaska 99697

Dear Home Power: WhatEVER is a retired journalism teacher doing writing a rhapsody in praise of an alternative energy mag? Well, its been a long time since my jaded eyes have seen the likes of HOME POWER, or feasted on such a palatable menu of info, philosophy, hope and IMAGINATIVITY! (Feel free to use my newly coined noun)

The writing, flavored with each expert's totally readable style, leads me, simple step by step, to higher complexities. I

intend to use your articles in the five schools in which I volunteer to teach "ham radio".

And all is permeated with a generous world view that is absolutely essential if our ravaged planet is to nourish life. Your PRACTICAL programs are a gift to the third world, to future generations, tinged with a touch of poetry: "the amperage and the ecstasy...the best lightning protection is a pure heart."

I even devour the ads, because they make sense and tend to be jazzy, like "Windlight Workshop", etc. etc.

Having lived on a sailboat (ever so lightly lived) for 30 years, and shared it with a lot of young people devoted to "making a difference"...our primary contribution to our time has been to help raise consciousness (that trite but transformational phrase) by communicating and cooperating locally, globally. We've created a ham radio network among schools that tries to problem-solve pollution, waste, violence, etc. With HOME POWER helping us teeter out on the cutting edge of humanistic technology, we declare ourselves henceforth one of your satellites, co-keepers of the light.

"Some say, I am laying bricks... others say, We are building a cathedral."

Cosmically yours, Mary Duffield, Co-Director, Redwood Youth Foundation, 2355 Brommer St. Space 23, Santa Cruz, CA 95062

Hello Home Power: Keep up the good work folks. Us backwoods, do-it-yourself types need all the technical info you offer in your magazine.

I have something to add to your article on Radiotelephones in Home Power #4. Not all Radio Common Carrier systems require operator assistance. The service that we use is direct dial in and out. We have our own phone number, even though it is a party line. A touch tone display is located on the back of the microphone. Also, we have two channels in our system. Incoming calls and in or out long distance are on one channel, while the second channel is for outgoing local calls. This allows us to make local calls without tying up incoming calls to everyone on the party line.

Some other points of interest I can pass along as a one year veteran of Radiotelephones-1) Stand by power consumption of our Radiotelephone (a Kenwood which was about $1200 w/antenna) is 0.45 amps @12VDC. Unless you use your phone alot the extra power used during conversations is negligible. I figure 12 amp hours a day (24 hours) for ours. 2) Quality of service from Radiotelephone businesses varies greatly. Check around, not just for price, but for dependability, strength of signal and "busyness". 3) Make sure you can get the signal from the repeater at your house. There are many dead zones in the mountains. 4) The basic monthly rate of a Radiotelephone is two or three times that of conventional telephones. On the other hand your radiotelephone can be sold for a good price, if necessary, where as the phone line you would pay to run in always belongs to the phone company. 5) If the reception on your radiotelephone is somewhat marginal, don't let your batteries get below 50% charge or reception may suffer. Make sure and keep your wire gauge large enough since your Radiotelephone draws 12 amps or more when talking ("keying the mike"). 6) Reception can be degraded during cloudy or windy weather, especially with a marginal signal. 7) Your Radiotelephone should come with a full one year parts and labor warranty or forget it. These babies aren't cheap to fix.

Just, want you good people at Home Power to know not everyone who reads your mag. is a subscriber. My neighbor brings over his, after he reads them for my inspection. This kind of "recycling" helps spread the word without burdening Home Power further financially, since you do it for free (amazing in this day and age!). Other subscribers please note!

Thanks again and by the way, my neighbor and I are 100% AE powered. No nukes, no dams, just a good feeling inside!

Craig Pageau, Fieldbrook, CA 95521

Thanks for your support and concern. Home Power's very life depends on our ad revenue, and this revenue depends on our circulation. So please sign up, Craig, and fill in the system info on the subs form. This is the best way you can help Home Power.

Q&A

We try our best to directly 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 to Home Power, but also for answers and comments from its readers. We try to answer as many questions as we can. Fact of the matter is that for every one we print, there are about 10 we don't. It's a matter of space. Hopefully, we will be larger soon and can deliver all the fine material that forlks have sent in. Thanks for your patience-- Rich

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Here are three responses to Frank Foseilles' questions on battery additives! Good Work Folks! Information sharing helps us all.

I will keep this brief & discouraging. Back in the early twenties my dad made batteries for the then new automobile. His was a one man operation as were many in those days. I learned the processes from him, although I never applied them. He kept the tools, which I still have. With that background let me issue forth.

First, you are working with metallic lead, red lead, white lead, and sulphuric acid. Not the safest bunch of materials. Second, most, not all but most, of today's batteries are not worth trying to recondition. They are made of the minimum amount of materials and when they are exhausted they are all done. The manufacturers are conserving valuable resources because most people would just discard them regardless. If you have the opportunity, compare a pre-WW-2 six volt battery with one of today's twelve volt - they are roughly the same size but the six volt weighs twice the twelve volt. Third, if your cells are assembled into a battery with lead straps you will have to cut the straps in order to lift the cell from the case, remove the partial strap from the post, etc. You now need molds to cast new posts and straps etc. If the cells are not connected with lead straps you can lift each cell out without damaging anything.

The greatest problem is sludge in the bottom of the cell which shorts the plates. This is a simple matter of discarding the acid (careful this is a controlled substance), washing the case, returning the unit, adding new acid and you are back in business. The next most frequent problem is damaged separators. This is easily repaired if you can get new separators. We used thin cedar sheets. Just slide the old separators out and slid new ones in. The next most frequent problem is warped plates. The simplest solution is to remove the warped plates and use the battery with fewer plates; there is a limit, of course. Beyond this you will need a mold to cast the grid, litharge paste to fill the grid, etc., etc. A bit much.

There is an excellent book which discusses this in detail with fine illustrations. Title- "The Automobile Storage Battery - Its Care and Repair" by O.A. Witte, Publisher- The American Bureau of Engineering, Inc., Chicago 1919. As you can see it was published almost 70 years ago. I am not trying to be funny - look in every used book store you come across (Which every AE person should be doing anyway).

Dad would have nothing to do with additives. In the early days a couple of his customers did add alcohol in the winter to keep the battery from freezing. Dad had to teach as well as work.

We enjoy your paper and although we are not now using alternative energy we experimented alot during the early seventies, had some success, some failures, some laughs, some cries. Although discouraging, I hope this letter contributes something to someone. Sincerely, Ray Ferriss, Oriskany Falls, NY 13425

BATTERY ADDITIVES are a RIP-OFF. They give the battery a chemical jolt for 5-7 days and then it's really dead. Dropping it on the ground from 1 ft. a couple of times and charging it works just as well. Love, Ogden Lafaye, New Orleans, LA.

And last but not least....

I have an old book book by George M. Hopkins, "Experimental Science". It contains construction plans for making Plante lead acid batteries. Also of interest is a thermoelectric battery as well as other items. This book is now being offered by Lindsay Publications, Inc., POB 12, Bradley, IL 60915-0012, (815) 468-3668. Yours, L.E. Spicer, Hydrogen Wind, Inc., RR#2 Box 262, Lineville, IA 50147.

Where can we purchase "extra-capacity" nickel-Cadmium cells D, C, and AA, as shown in HP#4, pg. 15, Fig. 2 "Nickel-Cadmium Batteries". Father Virgil Dusbabek O.C.S.O. Huntsville, UT.

Both Allied Electronics (800-433-5700) and Digi-Key (800-344-4539) sell extra-capacity nicads. We've had experience with the cells made by Panasonic & they are first rate.

How do you hook up two batteries (12 volt) to one 45 watt PV panel? Can you connect the 2 positives together and the 2 negatives together & charge & discharge continuously? Rosemary Arriye, Breckenridge, CO.

Yes, this is called a "parallel" connection and electrically makes both batteries into one larger battery. The voltage stays the same (12 VDC) and the capacity of the combined batteries is the sum of their capacities.

I've just received HP#4. What alot of good information in a small space! Congratulations! One question: In the "Things That Work" article on HP#4, a "deglitch capacitor" was mentioned as a means of reducing radio frequency interference from fluorescent lights. Could we have more information on this? Our AM reception is heavily impacted by our fluorescent lights. Thank You Very Much

Steve Benser, Waldron, WA.

Use a .01µf or a .001µf disk ceramic capacitor with a 25 VDC rating or greater. Solder this capacitor across the power leads, i.e. use the capacitor make a connection between the positive and negative wires feeding the fluorescent light. Do this as close a possible to the light. The interference you are experiencing is the radio frequency (RF) component of the micro inverter in the fluorescent lamp. The wires that supply the power to the lamp act as a broadcasting antenna for the lamp's RF noise. The deglitch capacitor shorts out the RF noise at the light and reduces the interference. Radio Shack

sells such capacitors.

Just read January's HP and have Feb. and March next in line, Thank You so much!! This mag. is much needed & I hope your time & energy is well rewarded! The whole mag. is informative & well written. Every article a favorite! We've used AE since '84 (so do our four neighbors).

Three of us will be putting in a deep well soon (500-600 ft.). Do you know of any DC submersible pumps or other alternatives like pump jacks (sucker rod systems) & costs? Peter Miceli, Taos, NM.

Well, with 500+ feet depth you are limited to a jack type pump. The people to talk to are at SolarJack, 102 W.8th St., Safford, AZ 85546, or telephone: 602-428-1092. They make high quality jack pumps that work at this depth and are powered by PVs.

Will coaxial cables pick up DC voltage when running next to DC cables. Tommy Tomlinson, Newcastle, CO.

No, DC wiring will not inductively or capacitively couple with coaxial cable. However, coaxial cable will couple with ac wiring, especially if the ac wiring is inverter supplied. So, keep your coaxial cable away from your ac wiring or you'll get "hum" on your radios.

We have two generators, 6 deep cycle batteries, a Trace inverter, & our house is totally wired for both ac & DC. Our main problem is we don't fully understand how anything in our system really works & how to best care for it. Any "simple to understand" information is desperately needed. Especially about how to charge our batteries correctly. We have a constant "low battery reading". Everything in our system is new. Our Trace inverter has the standby charger set at 14.3. We run our generator twice a day. Once in A.M., again at supper time... for doing laundry & dishes since our pump is still separate we need to for major water demand. We are totally perplexed as to why our battery readings are at a constant low. Perhaps you could attempt to answer this in "Questions & Answers". Also we have found out that NO banks in New York will carry a mortgage on our home because of no conventional power. We need to know if there are any "out of state" banks that will carry a mortgage on this type of house. Thank you again & again for your magazine & help. It is SO needed. Susan Mistico, Camden, NY.

It sounds like your batteries are never getting properly refilled. The Trace is user programmable and you must set the inverter's charger to meet your particular needs. Set the voltage limit on the Trace's charger higher to 15.3 VDC. This will more totally refill your batteries during your short recharging periods. You didn't mention your charge amperage setting or your battery's Ampere-hour capacity. The Trace is also programmable for charge current. In most cases, we set this to maximum current unless the battery is too small to handle the current. For short periods of time (less than 3 hours), charge rates in the C/5 to C/8 range are acceptable to lead acid batteries in good condition. Try these settings on your inverter's battery charger and see if they help.

As to financing, I've no specific info for you. How about it readers? Anyone know of a financial institution that is smart enough to finance real estate powered by renewable energy sources?

Here are two questions without answers, how about it, Readers?

For the past 12 years we have been using a Dunlite 120 volt wind generator. Unfortunately, it was severely damaged in a storm. Dunlite no longer makes wind machines and has no parts, so we are stuck. Do you know any source of parts for a Dunlite, 1976 model?? Frank W. Hansen, Box 2127, Tofte, MN 55615.

1. Super! Keep it up! 2. I loved my demand hot water heater until it died last month. Can you help me find another? Instant hot water & gobs of it for a small cost of propane. It worked 9 years before it blew a fitting. I can't find another fitting. It was a Thorn. Mrs. Irene Shadrick, Banning, CA.

Heliotrope

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the Wizard Speaks…

Resources ••• What can we say about our natural resources. First, the classical resources such as coal, oil, gas, and minerals are being rapidly depleted. Also, many of these resources as well as nuclear power are too polluting to be used as they are now. Alternative sources of energy exist in solar, wind, water, and wave technologies. We must also look at regenerative biological resources. If the present rate of deforestation and topsoil erosion continues, our planet may soon turn into one big desert.

Human technology has interfaced with the self-regenerating, self-regulating biological, chemical, and physical systems of Nature. The solution to this dilemma exists in the development of science and technology to the point where they can produce such systems. These systems would not only have to provide the necessary resources for human civilization but would also have to interface in such a way with the natural systems so as to provide for the continued viability of the planetary ecology.

What of human resources? The solution to this problem lies in the education of our children. We must stop stuffing their heads with data. The data exists. We must instead teach them to learn. We need to develop their ability to relate facts and experiences in both an intra and inter disciplinary manner. Simply put, we have to develop their capacity to directly process information. We need to create not intellect but intelligence and imaginative creativity. We must give birth to the magical mystic children who can bring to fruition all of humanity's finest dreams.

Living with a Windspinner

Anonomus * *This manuscript arrived unsigned from Traverse City, Michigan. We got a chuckle and thought you might too…*

He set the brake on the mill. Had to. It's been blowing "240" out there. Yeah, we're talking a "snainy" old ice-blizzard blowing with the gusto to rock and roll the most iron-clad of sensibilities to say nothing of that dinky-assed, human construct turbine (say with a long I) nesting fifty feet up that tower.

It's not like the tower won't hold. For crying out loud, he's got seven 3/8" cables "maypoling" the thing. Why you feel caged in any time you stand near that pole. I guess if you got the cable to do it, you might's well. To tell the truth, I been out there when that eastwind, that freaking coyote eastwind, been gusting 70. You look up there at that little sidearm mounted wind metering device and it's spinning 30… 40… 60… 65… hell… we could power the damn house on the anemometer! And the pole, you know, why it is just a statement of probability at best. I mean to say, it's not really there in the objective sense of the word. It's got an energy, a frequency, a humm, a vibration that may be coming from that old eastwind or maybe up from the Mother below-- a symphony, that's it… a composition being played out between the Earthmom and Coyote and we're right there, the Captain and me, hunkered under his teepee full of energy, praying to All our relations in the middle of a whole gale and the turbine aint even turned on…

So it's morning, the mill's still standing, coyote ice-blizzard ran off and torrid South is blowing a steady 20-- just about full power for the Winco. We decide to let the mill run free and bank some of that torrid South. Captain says it's the best wind to put in the battery: reasonable, warm, light and innocent. "The lights burn more steady, more cheery and bright, you know," he says. "You put that Coyote wind in there and them lights seem to flicker, like they're laughing at you. No… I try not to deal with Eastwind."

We head up the hill to the turbine, unfasten the brake cable and wait for rotation. I'm standing there, tower clinging, staring up the tower at the mill and I start losing my figure/ground sense. You know what I'm saying? I forget it's the clouds moving overhead and not the tower. I'm convinced the tower is swaying. "It's loose, man… It's loose…" But the Captain is more concerned about the turbine not spinning in a 20 mph breeze. He says, "Let go of that damn tower and stop staring… Lordy, I'd hate to have you turn selfless and get lost in the Void. I just got no inclination to be chasing you around everywhen. I think the blade is iced up."

The next thing I know, the guy's got an axe handle stuffed in his pants and he's "hand over handing" it up the tower. "Hold the brake," he hollers and starts tap tapping away on the blade. Ice chips are flying away in the wind as he tap taps, releasing the record of the storm and then he's ducking his head and screaming, "Let it go!" I release the brake and thwap, thwap it's powering up. "Come down," I'm shouting. It's starting (obviously) and the tower begins to vibrate. An intoxicating blast of sun illuminates the blade, it blurs with speed, the Captain is hanging one arm one leg, shielding his eyes and howling… increasing in pitch with the thwap, thwapping… howllll, until in a crescendo of multicolored rainbow, circular, galactic particles, like a smashed holograph, each particle containing the interference pattern of the Coyote/Earthmom composition of the night before, like a spinning, rotating, revolutionary, screaming hippy, get out the gun powder and cherry bombs fourth of July light show, the remaining ice breaks free and all I can say is, "AWW."

The Captain climbs down, we head in for tea and wonder if we ought to check the PV array next.

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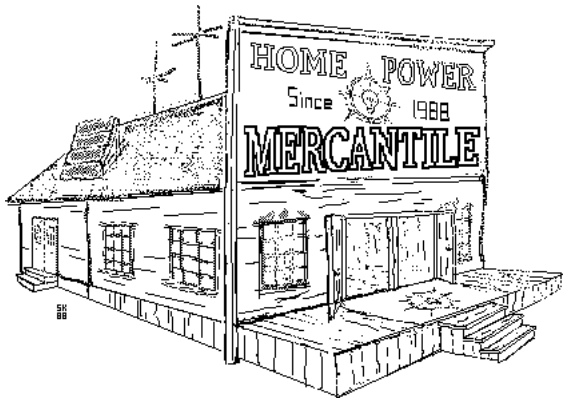

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