Energy Self Sufficiency Newsletter

June 2005

Off-Grid Living
Biofuels
Hydro
Solar
Wind

Summer's Coming!!

(In The Northern Hemisphere)

On Wheels, Off-Grid
Staying Cool Without Air Conditioning
Changing of the Guard at G-T * Book Review

A Rebel Wolf Energy Systems Publication

Cover Image: SOHO(ESA & NASA)

From The Editor's Laptop

by Larry D. Barr, Editor

Conservation Rocks!!

Remember a couple months ago (or so) when I started this saga and I was grumbling about my exorbitant electric bill and the fact I'd used 951 kWh in a 700 square foot house? We agreed that I'd been bitten by complacency, quite badly, and I promised to keep you posted on my progress.

Well, the bill is in from last month, my first full month with the conservation edicts in force (and, admittedly, some favorable weather) and the news is good. My consumption for the month was – drum roll please – only 228 kWh! Yep, and even considering that I'm paying a high commercial rate of US $0.1629 per kilowatt-hour and including taxes, my bill was only US $40.21.

Why, you ask, am I paying commercial rate for my electricity? When I moved in to this building (a one room office building, remember?) my landlord graciously offered to just keep the utilities in his name to save me changeover fees, deposits and such. Neither one of us bothered to think about the fact that the last "occupant" of the building was his construction company. Which paid commercial electrical rates. More complacency. Ya gotta consider *all* the details.

We're in the process of trying to change that. Don't know if we're going to run into a problem with getting the lower residential rate in a building that's zoned commercial , but being used residentially (~ $0.09/kWh). We're going to give it a shot though. That would get my bill down another 40% or so.

All right, I can hear the undercurrent of mumbling going on in the background. Folks around the world are saying, "He cut his electrical consumption by over 75%. What in the world did he give up?"

I'll tell you

I gave up about a hundred dollars a month in electric bills. I gave up the nagging guilt over unnecessarily burning "Essence of Dead Dinosaurs" at a Brobdingnagian rate and I . . .
. . . Oh! You mean what conveniences did I give up? Not a single one. There has been no change in the quality of my lifestyle as seen by a casual observer. Unless you consider having every light in the house on to be a statement of participation in the high life.

In practice, my lifestyle has improved. I just got a hundred dollar a month raise, if you want to look at it like that. And I do. Didn't even have to beg the boss for it. Just issued it to myself. And I did it by being kind to Mother Earth. That's a really good deal all around.

Those of you who've been following this series know what I've done to achieve the saving, but I'll recap quickly for our new readers. It started during late winter and I was sitting around the all-electric house in cutoffs and running the electric heater, leaving the water heater plugged in all the time and forgetting about phantom loads in all the electronics. Electronics is pretty much my life, so there were a lot of gadgets.

When I went into conservation mode, I put on a sweatshirt and didn't need to run the heater. I unplug the water heater when I'm not going to be using hot water. I put all the electronics on power strips and shut them off when I'm not using them. I sold the digital microwave and bought one with a mechanical timer. I replaced all the incandescent lamps in the house with compact fluorescents and built a 12 VDC LED reading light for my bed.

Now, when I leave the house the only things running are the fridge, answering machine, alarm clock and the clock in the stove. I'm just not going to pull the range out of the cubbyhole to unplug it. Everything else is hard switched off or unplugged. A little extra effort? Yes, but well worth it. Just look at the numbers.

I'm not going to stop here. I've been jumping between 3 and 4 computers, but I'm consolidating the silicon box situation and, within a couple weeks, everything will be done on one laptop, except for the rare foray into audio or video editing. I'll fire up the desktop monster for that. And I'm turning the computers off when I'm not using them. I'd gotten a bit sloppy about that.

You saw my desk-with-a-shelf "command and control center" in the picture for the 12 VDC laptop article in last month's issue. My next major project is to convert that desk to run all the devices from the battery bank, which will be charged from the PV panels. Full completion of the project is a little ways down the road, but it's in progress. I'll start by actually dual-wiring the desk for both AC and DC, to eliminate the cord mess on the floor regardless of how it's powered. And you'll be able to read all about it right here in ESSN.

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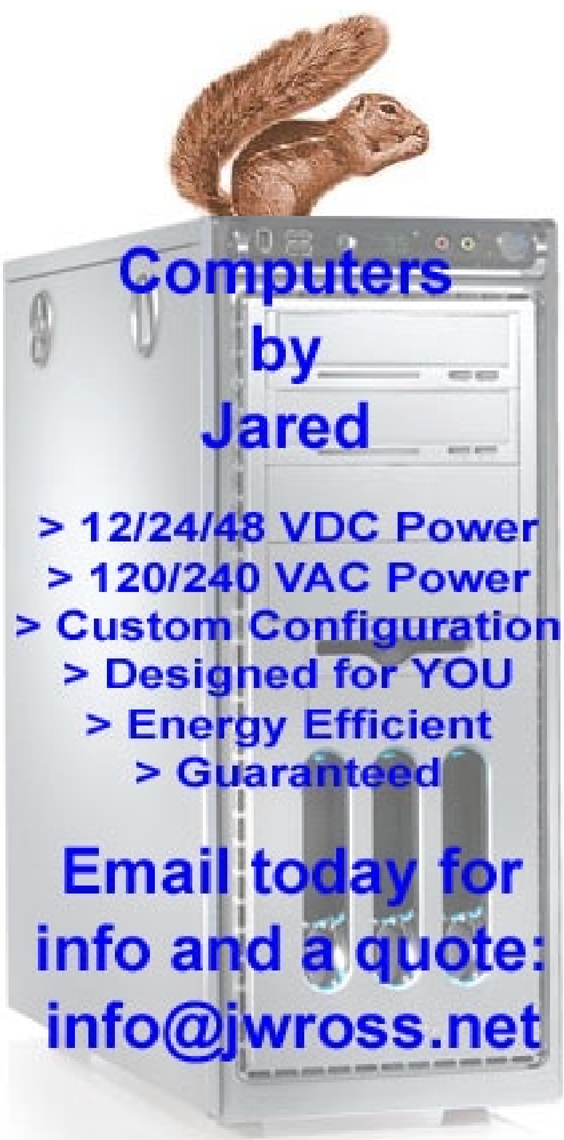
Speaking of ESSN, there have been a few changes in our organization this month. The pasteup duties have been taken over by Mike Nixon, our Kiwi Bloke, who is also our resident ethanol guru. We can look forward to a better looking magazine with the artistic reins in Mike's hands. (Pasteup comment ... Dream on Larry!)

And, there has been a "changing of the guard" at Green-Trust and, therefore, in the authorship of "Off Grid Journal." Steve Spence and family moved from the Green-Trust property for Steve's new 'real' job. The new on-site folks at Green-Trust are Greg and Chandra Warmoth and they'll be writing "Off Grid Journal" beginning this month. Steve has a couple great projects in the works and he'll be reporting on them in these pages.

One more thing about conservation that I almost forgot to mention. I feel like Columbo — "Uh, I almost forgot . . ." The habits that we build as we practice conservation will stick with us when we go off-grid and give us a real head start on efficient use of Mother Earth's resources. It's a great way to practice, and the rewards are magnificent. Conservation is the key to self sufficiency. **ldb**



BOOK REVIEW

Build a Solar Hydrogen Fuel Cell System

by Phillip Hurley

Reviewed by:
Steve Spence

Overall, this is a good introductory text to PV cells, hydrogen electrolyzers, and fuel cells. Written from a pro-hydrogen standpoint, it glamorizes supposed advantages of hydrogen storage over battery storage systems when, in truth, both suffer from very similar issues. It also glosses over certain disadvantages of hydrogen systems, like the reduced efficiency of using more electricity to convert water to hydrogen and oxygen than you get back when you convert back using fuel cells. Still, it's a worthwhile text if you want to learn about alternatives. Very hands on, it takes you through the concepts and gives step by step instructions for producing hydrogen from the power of the sun. If PV cells are not available, an AC to DC power supply could be substituted.

A comprehensive book with 249 pages in 11 sections, available as an electronic download for $16.95

The first section covers the overview of the project, discussing why it should be done, the benefits, etc.

The second section is an overview of PV technology and panel types.

The third section walks you through assemblying a PV panel from cells. These cells can be obtained fairly inexpensively from surplus and off spec parts. Pre-assembled panels could be used as well. This in itself was worth the price of the E-book.

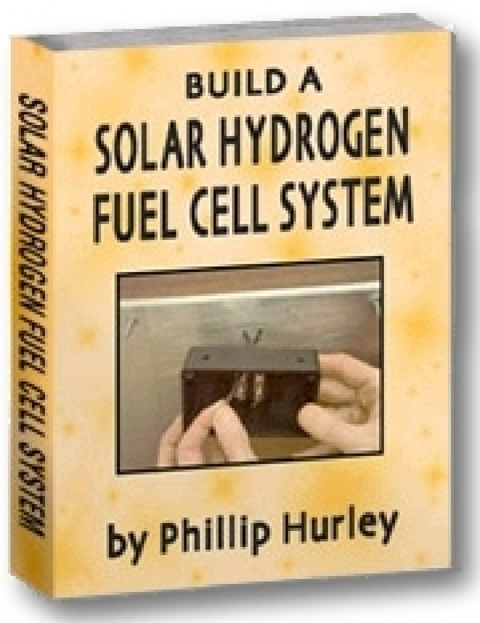
The fourth section covers electrolyzer basics and types.

The fifth covers construction of the electrolyzer, using common, off the shelf components. Some basic shop equipment is necessary, but nothing complicated.

The next 4 sections cover gas safety, filtering and storage.

The last 2 sections are about building a fuel cell.

All in all, a very good text, with sufficient diagrams and photos to illustrate all the key points. Hydrogen from electrolysis is an energy intensive process, and not very efficient, so storing the PV electric in a battery gives you more return on your investment, and with less complexity. For those interested in an alternative hobby or science project, I recommend this book.



This book can be obtained at
http://www.goodideacreative.com/shfc_sys.html

On The Bright Side

A 12 VDC 20-LED Desk Lamp

by Larry D. Barr

It all started off as a six buck 120 VAC incandescent task lamp from Wal-Mart. But, you know me, I just had to see how easy it was to convert it to 12 VDC. Since it was a desk lamp that wouldn't see much use, my first thought was to just replace the incandescent bulb with a 12 VDC unit. Not that bad an idea, really, but it was soon shot down. Seems that the bulb was a very uncommon style and there's no 12 VDC equivalent for that base. Time to invent Plan B. Or, in this case, Plan LED.

I had a drawer full of 10mm 15,000 mcd white LEDs from MPJA and it was time to put some of them to work. A further rummage through the junkbox turned up a Radio Shack project board and the game was on.

The first order of business was to mount 20 LEDs on the board in five rows of four LEDs each. There's nothing sophisticated about my mounting method, just a drop of cyano-acrylate adhesive under the base of each LED. It's a lot easier to solder the connections when the LEDs aren't free to move at will. Once the CA set up, I soldered all the LEDs in parallel, tied in a length of 2 conductor zip cord to connect to the base of the lamp and installed the resistor and the switch in the base.

You figure the value of the resistor using Ohm's Law. Multiply the individual current draw of one LED by the number of LEDs, and divide that number into the voltage difference between your source voltage and the LED voltage. Then take the next highest standard value. For the LEDs I used, the numbers worked out like this:

Source Voltage (E_S) = 12.6 VDC
LED Forward Voltage (E_{LED}) = 3.8 VDC
LED Forward Current (I_{LED}) = 20 mA = 0.020 A
Total LED Current (I_{TOTAL}) = 400 mA = 0.400 A

Here's how the math works out:

$R = E/I$
$R = (12.6-3.8) / 0.400$
$R = 8.8 / 0.400 = 22$ ohm

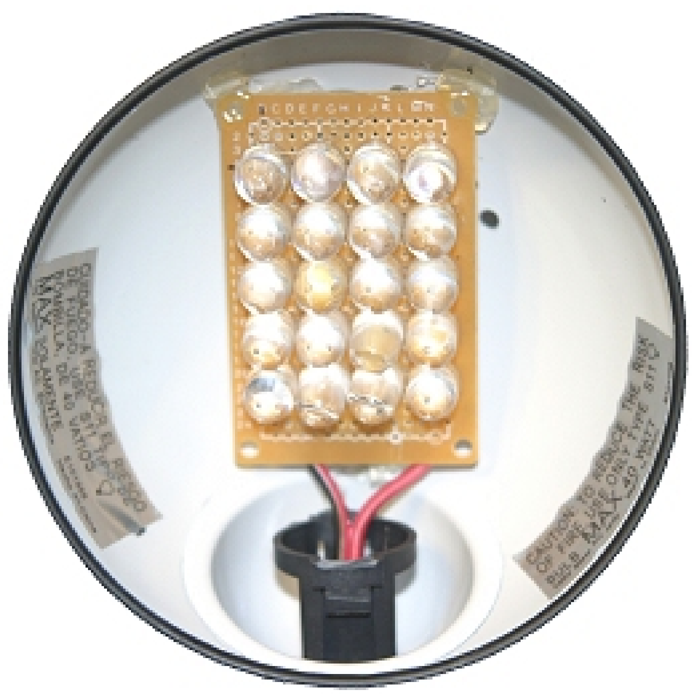
I paralled three 100 ohm 2 watt resistors that I had in the drawer for a resistance of around 33**?** (allowing for tolerance). That's a bit higher than really needed and cuts the brightness of the lamp just a little, but it's still plenty bright enough.

There's absolutely nothing sophisticated about my mounting system for the circuit board. I just used a couple of rubber feet from a scrapped electronic device of some kind (they were in the junkbox), cut 'em a bit so they fit the angle of the shade and held it all together with some hot glue. That probably wouldn't work with an incandescent bulb, but the LEDs won't generate enough heat to cut 'em a bit so they fit the angle of the shade and held it all together with some hot glue. That probably wouldn't work with an incandescant bulb, but the LEDs won't generate enough heat to cause a problem.

There's been a fair amount of discussion on some of the message boards recently talking about the best way(s) to connect LEDs in projects such as this. There are three choices: parallel, series, and series-parallel.

A parallel circuit connects all the positive (+) leads together and all the negative (-) leads together. This type of connection has both advantages and disadvantages. On the positive side (sorry), in the event an LED fails, the rest of them will continue to operate. However, this connection scheme does draw more current than a series circuit and therefore requires a series resistor for current limiting.

In a series circuit, LEDs are connected in a string with the positive (anode) of one LED connected to the negative (cathode) lead of the next. Again, there are pros and cons to this method as well. On the up side, a judicious selection of components can negate the requirements for a current limiting resistor but, like the old Christmas lights, the failure of one LED will extinguish the entire string.



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Series-parallel is simply a combination of the two schemes and is probably the best arrangement for large arrays of LEDs. It offers the best of both worlds in that you have more control over the total current draw of the array and eliminates the possibility of total failure which is inherent in the full series system.

I'd originally planned on a potentiometer (pot) to act as a brightness control for the lamp, but I didn't have one in the junkbox with enough current carrying capability to handle the load, which is around 400 mA. That bit of thinking ahead (or not) explains the extra hole in the base of the lamp. I drilled before I tested.

So, I ended up with a simple on/off switch to control the lamp. Just as a matter of habit, and industry standards, the switch goes in the positive lead from the battery. The red/black zip cord, which I got from PowerWerx, is terminated in Anderson PowerPole connectors to mate with the rest of the wiring for my 12 VDC system.

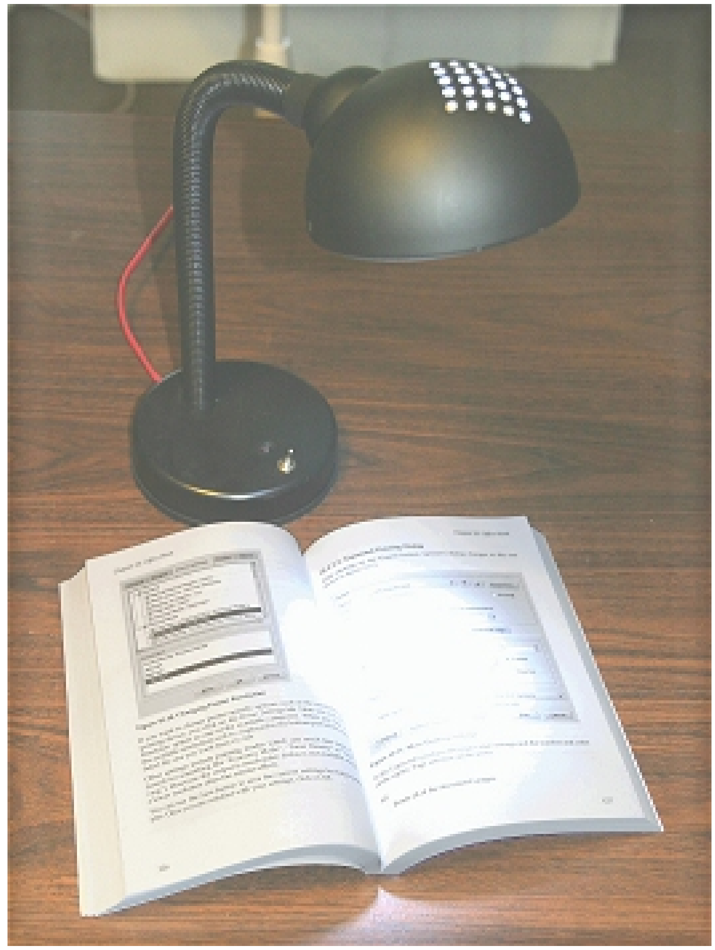
If you haven't discovered PowerPole connectors yet, you should certainly check them out. The PowerPole connectors are the standard for both ARES and RACES, the two most prominent amateur radio emergency networks.

PowerPoles provide a reliable, consistent standard for 12 VDC power connections and, in my opinion, should be adopted as the standard for renewable energy systems. Give 'em a try, and if you like them as much as I do, spread the word. They're available, along with the zip cord, from PowerWerx.

By the time all the solder had cooled, I had a very nice desk/task lamp that only draws about 400 mils from the 12 VDC system. It's bright enough that it makes reading easy and I've used it a couple times for illuminating plans for future projects. Sometimes, it's actually a little too bright and I'm probably going to get a pot that will handle the current necessary to act as a dimmer for it. Back when, in the analog days, it was easy to find a potentiometer that would handle more than a few mils. But with digital devices taking over the world of electronics, many components are not readily available in the relatively higher ratings.

In the digital domain, pulse width modulation (PWM) looks like the best choice for control of LED brightness. PWM involves a circuit which applies the full voltage to the LEDs, but only for a small portion of the operating cycle. A digital timer circuit controls the "duty cycle" of the applied power, sending it to the LED in short pulses. The duration of the pulses controls the brightness of the LED. The longer the pulses, the brighter the light. We're currently working on an article on PWM control of LED brightness for a future issue of ESSN.

In summary, this very simple and inexpensive 12 VDC LED desk lamp can provide useful illumination for any off-grid application. It's very probable that a PWM controller will afford a dimmable lamp with a lower total energy consumption, but this unit is a great way to start. **ldb**



Transitions and New Beginnings at Green-Trust

by Steve Spence
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As many of you are aware, Green Trust is going through some transitions. New folks are coming on-board, and I am taking on a different role due to career changes. My work as a Network/Security Engineer required me to move to the NY Metro Area, and away from the Green – Trust facilities. This required me to find a new researcher and off-grid compatible couple to take on the responsibilities of maintaining the facilities and developing new projects and technologies onsite. Greg and Chandra will be located on the property shortly, and will be introducing themselves here, as well as their proposed projects, including rain water recovery, composting, and organic gardening.

My role as Director of the organization has not changed, and I will be maintaining the website, doing advocacy work, and working on special projects, like the new vegetable oil powered Eco-Bus, and the solar hydrogen system. I'll continue here in these pages doing equipment and book reviews as well. I am continuing my work developing biodiesel processors, and cold-climate waste vegetable oil fuel systems. We are coming out with a new system based on insulated water heaters as fuel tanks, which require less energy to heat and maintain the heat.

I promise to finish the articles I started on both the biodiesel processor and the VeggieGen fuel system, which were greatly delayed due to this transition, and technical issues.

Chandra with youngest daughter Javen

WELCOME!

Chandra Warmoth

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Hello world! I'm Chandra, one of the new caretakers for Green Trust. Though Green Trust is in NY, I am writing to you from sunny … no that's not true ... from *dreary*, chilly Indiana. A few bumps in the road (or should I say potholes) have held us up, but we'll be there soon! Until then, I've been flexin' my wanna-be hippie muscle and thinking of what we'd like to do for Green Trust. My biggest goal on the energy-side of things will be to rely more upon solar and wind power, using the good-ole VeggieGen as more of a back-up than a mainstay. I plan to accomplish this by attending the Wind Turbine workshop, hosted by James Juczak of BackHome NY, at the end of July.

Since we'll be arriving a bit too late for any hard-core organic gardening, we'd like to fence off the planned garden area and give a few pigs a go at the ground for a few months. Steve and I discussed this, and we think it will really prepare the soil well since it's not been planted in yet. Building a chicken coop and getting a few chickens and/or ducks is next on the list, rounded off by building a two-sided compost bin. Plans stretching a bit further into the future include utilizing the wood stove to heat water, expanding and re-routing the rain-harvesting system to be filtered for shower and toilet use, and fixing the propane fridge. We have plenty of plans brewing, and can't wait to put them in action! We'll be sure to keep you up to date on our first voyage into the world of Self-Sufficiency and Renewable Energy.

On Wheels, Off Grid In Africa

Where Self Sufficiency was a Fact of Life

by Suzanne Ubick

It all seemed to happen very quickly; on my 19th birthday I was a happy research technician working for the Chemistry and Soil Research Institute in what is now Harare, Zimbabwe. Three months after that I was married, had moved to South Africa with my new husband, and moved into a caravan.

My husband was a geotechnical surveyor, meaning that he operated different kinds of drill rigs to find out what lies beneath. This could be for mineral exploration – we went after anthracite, gold, platinum, and nickel – or for freeway expansion or building of high-rise edifices. Our company sent us all over southern Africa. We spent six months in Swaziland, two months in Lesotho, a few days here and a few days there, for seven years.

I enjoyed the travel, and was never disheartened in any way by being off-grid. It was fun to tap water from a drum with a spigot in its bottom; fun to put a black plastic 50 litre drum in the sun in the morning, fill it with water and use that water to bath in the evening. I was never hassled by fire-making for water heating on cold, grey, drizzly days. Living very frugally with water and energy became a way of life and a never-ending source of entertainment - it was a challenge to find ways to do things without electricity, and with minimal other resources. During this first seven years, I gave birth to two children, which lent impetus to my efforts to do things quickly, efficiently, and cost-effectively.

The caravan was equipped with 12v fluorescent lights, and had a tiny LPG stove and refrigerator. At night I simply clamped crocodile clips onto the Land Cruiser's battery, and there was light. I was totally dependent, however, on my husband for cylinders of gas – I do not drive – and became downright parsimonious with gas, continually looking for ways to use less and do more.

Seven years later, all of this was intensified when our daughter was ready to start school. We had bought 56 acres of secondary thornveld, 60 km from Pretoria and 14 km from Hammanskraal. The school bus stopped at our gateway. We parked the caravan under a spreading wild syringa tree, and I was left to get on with it. The only service we had was a telephone – one of those Number Please jobs. My husband was often away for months at a time. He'd come home once a month, and we'd do a bulk shopping trip.

Now, of course, I had no access to the Land Cruiser battery. So I bought paraffin lamps, and got a 20 litre drum of paraffin every three months. It's a very restful light, and the portability of lamps meant I could move them to wherever they were needed. They are fairly high-maintenance though; every morning I would trim the wicks, fill the bowls with fuel, and wash and polish the chimneys. The lamps were also useful for heating/cooking. I discovered that if I put a tripod over the chimney, I could quickly boil water for tea, warm milk for a restless child, or fry an egg, or even make toast provided I didn't wander off and leave it unattended. This multi-usage saved a lot of gas over the years. My back-up lighting was candles and flashlights, just in case I ran out of paraffin.

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This little river can rise within minutes should a storm crest of runoff hit it from the hills. Before you can say "Goodness gracious!" brawling waves ten feet high are charging downstream faster than you can run, scouring the banks clean for yards on each side.

I started building. We had hired a local man, Elias, who lived on our property with his wife. First he built himself a small house to replace the dreadful old tin shanty that came with the land. Then we started on the farm projects. The first thing we built (and I do mean we – Elias is a skilled builder, but I got a goodly share of mixing concrete in wheelbarrows and helping to cart rocks) was a large kitchen. Actually, at 6m x 6m, it could be a whole little house on its own. We used the plentiful local freestone to build, and roofed the structure with gumpoles and corrugated iron. This is where we lived, my two children and me all the time, and my husband sporadically.

One corner was our bathroom, with a big plastic tub. Another was the kitchen area, where I had an LPG stove, a sink, LPG fridge and later on a freezer, and a big table. The rest of the space was our living area; the caravan was the sleeping place. My kids each had a bunk bed, and I had the double bed. At least, that was the theory. In practice, I'd usually wake up with both children, two cats, and an assortment of dogs. The day I woke to find myself nose to nose with a red-lipped herald snake snoozing beautifully on my pillow, was decidedly memorable. My gang of predators was snoring around me, quite unperturbed by its presence. I took the serpent by the neck, took him for a long walk and released him near the seasonal creek a kilometre or so away.

Despite what you see in the picture of that creek above, water was still in short supply; we had drilled a 90 metre borehole, but this was granite country. We intersected a couple of veins of water, but no great pockets. This meant that we could pump the borehole dry, get 1,000 litres of water, and wait 24 hours for it to refill. The water was needed for my household, Elias's household, and the dairy cow I soon purchased. The answer was to harvest rainfall. The Farmer's Weekly had a great article on using plastic irrigation pipe to gutter one's roof; take a length of blue pipe to fit your roof, slit it length-wise, and clamp it over the corrugated iron. It worked! So we put on a bend, and short downpipe, and a water tank on a stand so that its bottom was a hair or two above the level of the sink. Black polythene piping gravity fed the sink and the bath with cold water. It worked, very well. And the tank had another use: it turned out to be a wonderful lightning conductor.

I'd read John Seymour's book on self-sufficiency, so when we built the donkey boiler, I used his design principles to get as much use from the fire as possible. The firebox area had a metal plate over it; the chimney from this cooking surface fed a solid stone chamber with a 44 gallon drum in it for heating water, and above this there was another chamber I could use as an oven.

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Somehow our dogs just burgeoned. We started with one, a Staffordshire bull terrier male named Chaka, whom we bought deliberately. Then a neighbour's Akita had puppies and no milk, and I ended up rearing the puppies on a bottle. The mother's owner took back two of the three pups, and left me with one. Misha was a wonderful dog; she looked like a smallish yellow wolf and was the very best watchdog (apart from the snake episode) who has ever shared lives with me. I had her spayed. BUT – the word was out in dogdom, and I suspect that people moving back to town dumped their dogs on my property. At any one time we'd have around seven dogs to feed, ranging from the tiny black mongrel Ben to the huge Rottweiler Big Ben. I'd feed up the dogs, have them spayed or neutered as required, and find homes for them.

No, this is NOT one of our dogs! It's a Dassie. Despite this tailless creature's goofy expression, it is not to be trifled with. Those Bugs Bunny teeth can slice through a finger as if it were a carrot. Also, this closest relative to the elephant can climb trees. At sunrise and sunset, they vocalise in chorus with piercing shrieks.

It would have been prohibitively expensive to feed the dogs out of the bag. And I'd acquired three pigs – I don't know how this happens, folks, but somehow animals just appear in my life! I figured the dogs and pigs were all monogastric, and could all eat the same food. And while I was at it, the chickens could share it! So each morning a fire would be made and a half-drum set on the metal plate. Water, corn meal, meat, and vegetables went into this and I, like a witch on the blasted heath, stirred my cauldron till it bubbled. In the meantime, the bread I'd put into the oven was baking, and the water in the big drum was getting good and hot. My donkey boiler was fed with cold water from the water tank, and the hot water gushed into my sink. I'd take buckets of hot water to the tub for the laundry, or for bathing purposes.

After the last person had bathed, I'd put the laundry into the tub and add soap flakes. Once the kids had gone to school and the morning chores done, I'd add a bucket of hot water to the tub, fetch a book, take off my shoes, step in and proceed to tramp up and down. Sometimes I'd even dance on them! Once I figured the clothes should be clean, the tub would be drained and rinsing water added. Another drain, and another rinse. The second rinse water was usually clear and limpid – so it was saved for bathing in. All the soapy water ran through a large-bore hose directly into the veggie garden. If I wanted to mop the floors, I'd save a couple of buckets of the first rinse water for the purpose. And then the clothes went onto a line; outside over the grass patch that served as a lawn in good weather, onto the porch in wet.

Water was always on my mind. Tooth cleaning was done with a half-tumblerful of water. I had a special plastic bowl for hand-washing; a cup or so of water went into it, and the hand-washer wetted his hands, squirted a blob of shampoo into his palm, worked it all over, and then rinsed in that same pint. Why buy liquid soap when shampoo is practically the same thing, at half the price? And when water was really low, like midwinter when there was no rain, and the borehole was sluggish, we'd take birdbaths. Same system as the hands, but with about a litre of water .Wet washcloth and rub over body. Repeat with blob of shampoo. Wring out cloth, dip into water, and rub off shampoo. Continue to rinse until the soap is all gone.

People would come to visit, and be appalled by my primitive home. What, no washing machine? No microwave? No toaster? And may all the deities preserve us, no TV!!! I didn't need any of those things and saw no reason to lumber myself with a generator to feed such appliances. For a while I did go crazy about hand-cranked gadgets; I'd buy and try anything that looked useful! But when the frenzy was over, I found that all I really needed was a chopping board, assorted knives, a grater and a citrus squeezer – the plain old glass bowl with cone type. Preparing food was just about as quick and there was far less clean-up. I did have a churn, a Dazey that I bought at a junk yard, really cheap. I didn't have, or need, a cream separator. The milk went into dishes into the fridge, and in the morning I skimmed off the thick yellow cream, leaving the thin coffee cream in the dish. I made butter three times a week, the sale of which paid the entire costs of my cow – including inoculations and vet visits. The butter milk went to my rabbits – yes, another enterprise had come up like a toadstool in the night. Milk left over from the day went into a big unfired clay pot, with a cloth over it. Evaporation kept the milk cool, and it made high quality 'dik melk' (thick milk) that was solid as yoghurt but still sweet. The local Black population bought this – I never had enough to meet the demand! So I was making a nice profit on the whole thing.

I'm lazy by nature, and nature herself tends to be very efficient. My cow ate grass and browse. She got a salt/mineral block, and I mixed feed to keep her happy while being milked. This was mostly lucerne (alfalfa) hay that I got in bulk from a neighbour, with some corn meal (sweepings from the Hammanskraal mill) and molasses meal to give it interest. I didn't go through the rigmarole of taking the calf away, milking Lissie, putting milk into a bottle and feeding the calf. Despite all the grim warnings I got, I left the calf with her ma, separating them only at night. In the morning, I'd milk out two or three quarters, depending on the stage of Lissie's lactation, and then open the gate for the calf to charge in. Then they'd go off together for the day, coming home at sundown. This method gave me at least 15 litres of

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milk a day, and beautiful fast-growing calves that never got scours and weaned naturally at six months – just about the size of their mother. I kept the first calf, Vixen, and she became my second milch cow. I swopped another heifer (beginner's luck, we never got a bullcalf in 5 years!) for a beef animal, and sold two more at good prices. The calves were always friendly, as well they should have been! Their mother was very docile, and every time we met I gave her a tasty little treat, so they associated me with ear-scratching and food. Despite this evidence, every one of my neighbours told me very seriously that one HAS to bottle-rear a calf if one wants a tame cow. Hey, I never had to chase an animal! When the vet came around, or if I wanted them for any reason, all I had to do was call and they'd come thudding up – cows, sheep, goats and pigs in a noisy jostling herd.

I started growing maize. At first I actually shelled the cobs for my cows, using this grain instead of the purchased corn meal for the dairy feed. One day Lissie walked up, wrapped her tongue around the cob I was about to shell and pulled it into her mouth. We were onto something now! Cows can just suck up dairy meal, but it took Lissie a good 20 minutes to pulverise that corn ear and she wasn't twitching until it was done. I continued to husk the ears, a la Industrious Smallholder. Then Lissie got into my little corn field, and showed me that she was completely content with the ears still in their husks. And the stems were fine too, even whole and dry…

Yes, I'm lazy by nature. The pigs started off in lovely custom built freestone styes with heavy thatch roofing – sounds expensive, but the rock and the thatch grass were to be had for the garnering – next door to the kraal for the sheep, goats and calf. I cooked up drums of food for them, filled their water buckets several times a day, and shovelled manure out of the pens. The pigs, Porcas, Dorcas and Robinson, grunted heartbreakingly when the ruminants went off to graze, and spent a lot of time peering wistfully over their walls. Of course, one day I was cleaning a pen and inadvertently let a pig out – and away she went! At sundown, she trotted back with the other animals, happily twirling her tail like a stripper's nipple tassel. From then on, the pigs went out with the other animals – and I never had to clean a sty again. Given the choice, pigs will not crap on their own doorsteps. And they'd trot about busily with mouthfuls of dry grass and arrange their beds to suit themselves. They ate anything and everything they found during the day, cutting down the amount of food I had to cook for them by about half. They drank from the water troughs fed by the pump on the borehole. They were very happy pigs. Porcas and Dorcas never squashed their babies – they'd build a haystack and hollow out a cave in which to give birth. Even if a sow should flop onto a piglet, the resilience of the hay protected the piggie.

I got more and more interested in natural systems. I wrote to the Department of Energy, and was deluged with information. I wrote to various manufactures, and acquired brochures on solar power, wind power, pelton wheels (yeah, right!) and ram pumps. I read voraciously – the Farmer's Weekly was a great resource. I rediscovered holism - thought this was my very own concept (I was spelling it

Not quite Lord of All I Survey, here I'm striding through the grassland alongside the fence separating South Africa and Swaziland.

wholism) – when I was following up on Jan Smuts' grazing experiments. After some very painful experiences with a diesel generator, we finally equipped the borehole with two solar panels and a 12 volt DC water pump.

A lot of my self-sufficiency attempts were driven by shortage of money, and the fact that I don't drive. But a lot of it was fuelled by natural frugality, and a burning interest in closed systems that just keep running all by themselves. I've been an ecologist since I was a tot – it always hurt to see the uglification of the environment. Wasteful ways grated on my nerves. My husband, unfortunately, saw me as cheap and stingy. He was a conspicuous consumer; he really hated my mindset. The marriage, which had no real foundation, crumbled like a stale scone, although we stayed together for the sake of the children – don't ever do this! It was the very worst mistake of my whole life, and the repercussions will be with us all for ever.

Thrown more and more on my own resources, I became obsessed with self-sufficiency. I glowed with pride when the meal on the table was all home-produced. All our bread and baked goods were made at home – from purchased flour and sugar. Butter, cream, and icecream were plentifully supplied by my dairy operation. I made jams and chutneys from wild fruits. We had an abundance of eggs, from the hens – they too ended up joining the free-range herd. Meat was home-produced. Small animals were shot and beheaded by a neighbour, skinned and dressed out by me. The local butcher took my beef animal away in his truck, and brought it back in packets, blast-frozen and labelled. His payment: the head, horns, hide, feet and innards. He'd also swop his specialty sausage for bones and fat. I sometimes carried things too far; like when I found myself

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using a knife to whip egg white on a plate, as recommended by anold cookery book. 45 minutes till they were stiff enough, and I was stiff the whole next day.

I made soap a couple of times; it never quite set. My children loved it – they called it "monster slime" and were only too eager to bath themselves, the dogs, the cats and anything else they could anoint with the brown ropy gel. I bought books wherever I found them, old books, pre WWII, because those were written for people who HAD to mix their own feeds, HAD to preserve their own food, HAD to make a good deal of their clothing. I got a hand-operated Singer sewing machine, and cut our clothing bill by 75%. Even now, all I ever use is straight stitch and zigzag – I prefer the look of handmade button-holes and hand-whipped hems.

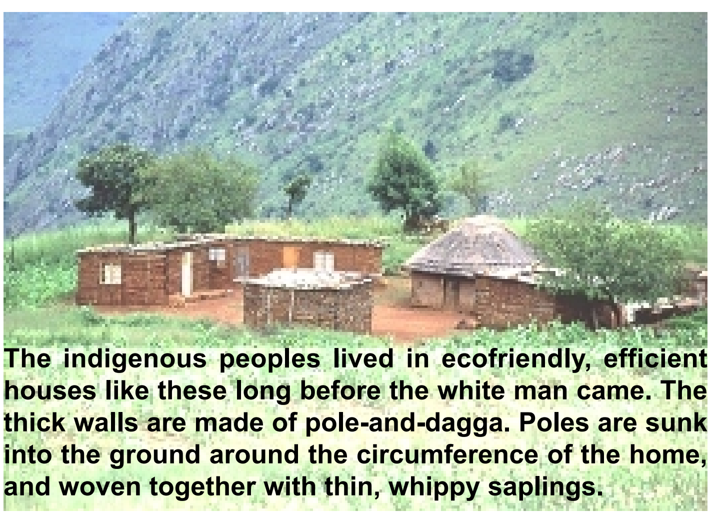
Fast forward: one divorce, one stress-laden career, and finally one more marriage later. I live in San Francisco, and my new husband fully supports my frugal ways, being a bird of the same feather. We have two plastic dishpans; one has soapy water and the other plain. Plates are scraped into the compost bucket. Starting with non-greasy stuff and finishing with pots and pans (first rubbed well with crumpled newspaper to absorb the fat), a day's worth of dishes is all washed by hand in these two gallons of water, and then the water is taken to the garden. Unless I want to mop the floors – the rinse water does a great job before going out to the garden. I still do the housework by hand; a dampened broom works as well as a vacuum cleaner for picking up dust and pet hair. I can make a cake as quickly by hand as with a mixer, and have less to wash up. I have one of those hand-cranked salsa maker appliances, which whisks egg whites really stiff in LESS time than the electric mixer does, chops onions tearlessly, and even makes good butter. Now and then I succumb to the yearning to make butter, buy a pint of cream and have at it! It costs the same as buying butter, but I get about a half-cup of buttermilk into the bargain. I've even used this gadget to mix a butter cake, and it worked well.

True Confession coming up: I use an electric toothbrush, battery-powered. This, with the use of baking soda and salt as a tooth powder, saves me three visits a year to the dentist, and about $300 in copays on plaque removal….

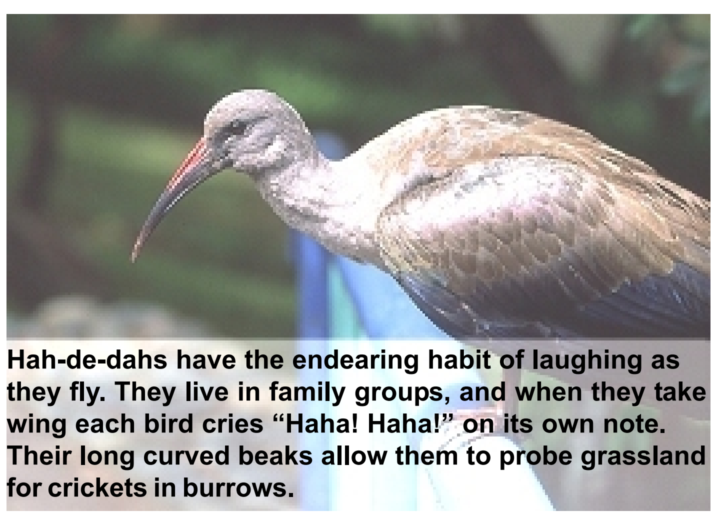
Suzanne Ubick

Thornveld savannah covers vast stretches of South Africa, particular zones underlain by granites. It's incredible rich in species diversity, from pigmy crickets to stomping, ever-irritated rhinos.

It was baking hot and blindingly bright on the dirt road in the borderlands between Swaziland and South Africa, but going down into the forest felt like diving into a cool well.



The indigenous peoples lived in ecofriendly, efficient houses like these long before the white man came. The thick walls are made of pole-and-dagga. Poles are sunk into the ground around the circumference of the home, and woven together with thin, whippy saplings.



Hah-de-dahs have the endearing habit of laughing as they fly. They live in family groups, and when they take wing each bird cries "Haha! Haha!" on its own note. Their long curved beaks allow them to probe grassland for crickets in burrows.

STAYING COOL

Fifth in a series of Articles on
Passive Solar Building Design
by Laren Corie

This month brings in the beginning of summer, and our thoughts turn from keeping warm, to staying cool. Keeping a house cool by natural means is a huge subject, that I will no more attempt to cover in one article, than I would heating. In future issues of ESSN we will be paying a lot of attention to this subject, and will discuss the various aspects of siting, orientation, shading, reflection, venting, thermal mass, and insulation. For now, I want to do a brief introduction and overview, with a leaning toward approaches to reducing overheating and cooling loads in existing houses.

Those whose houses have their long walls facing north and south will not only receive much more beneficial warming sunlight in wintertime, they also get way less unwanted heat in the summer, when the sun spends long hours shining on the east wall, and much of the afternoon relatively low in the western sky, blasting the house walls during the hottest part of the day. There is usually nothing we can do to change the actual orientation of a house, but we can keep it in mind as a factor whenever we are making decisions about the planting, construction, and painting around the house. Those things can be used to change the effective orientation, by reducing the degree of exposed surface area.

Last month I discussed shading with overhangs and vegetation. While south walls, and even south windows are quite easy to shade, often to the point of over shading, I can not overemphasize how important it is to shade west facing windows. Not only do they receive the most sunlight in the hottest months, they receive it during the hottest part of the day. In some southern states, around June, even the north wall can receive more sunlight, than the south wall. The east, west, and north walls all receive light, from the sun when it is low in the sky. The roof is also a form of shading, as it sets above the ceiling of the living space, blocking sunlight from penetrating. It receives far more sunlight during the cooling season, than any of the walls. Though we never use just a single approach, shading is usually the most effect of the passive cooling strategies, because it stops the heat before it ever gets into the house, or even onto its outside surfaces.

When sunlight does reach the surface of the walls or roof, lighter colors will absorb much less light, therefore far less heat than darker colors. This is even more critical for the surfaces which receive the most sunlight, like the roof. Regardless of ventilation and insulation, light colored roofing is an effective strategy for keeping a house cool. There are also special paints, which reduce the absorption of heat. However, they usually make a difference of less than R1, so care must be taken to not over-value their effectiveness.

Most sunlight is visible light, so simple white paint is extremely effective at reducing surface temperatures from Solar gain.

Ventilation is another basic cooling strategy. It can be used to carry excess heat and humidity out of the interior, or to increase evaporation on our skin. It can be driven by wind, fan, or warm air rising, in what we call "stack effect." Air movement can cool people directly, or can be used to carry away heat from massive materials (thermal mass) in the house at night, to keep it comfortable the next day. Air can even be drawn through tubes underground, to bring ground temperature air into the house. Air movement can cool us up to our body surface temperature of somewhere between 92° and 94°F. Above that, it will only heat us further. With a relative humidity around 50%, the combination of shading and air movement can keep us comfortable at 90°F (32°C). Even at 90% relative humidity, we can usually do well at up to about 83°F (28°C), as long as we have a breeze, and are out of the sun.. This, of course, will vary from person to person, but as a general rule, most of the time, in most climates, a combination of shading and a breeze can keep you cool. That is what ceiling fans do so well.

I briefly mentioned thermal mass earlier. Thermal mass is the ability of a material to absorb and release thermal energy (heat), for every unit of temperature change. It is why a cup of 140°F water could scald you, but a little blast of 140° air could even feel good. When night time temperatures are comfortably cool, thermal mass can be used to average out the hotter daytime highs. Unfortunately, there is a danger in reality, that thermal mass also stores daytime heat, to cause higher nighttime temperatures. This is a major factor in most nighttime household overheating. The solution is usually to reduce the amount of daytime overheating by a combination of shading, ventilation, and insulation, butif your daily average temperature is uncomfortably high, you don't want thermal mass.

Insulation comes in a wider variety for keeping heat out, than just the standard types we usually associate with keeping it in during cold weather. Standard fill, bat, blown-in, spray-on, and foam board insulations all work similarly, or in the case of fiberglass, even better in the cooling season, than in times of heating need. Attic insulation is usually a very effective 'cheap trick' You can buy cellulose insulation to blow in 6" for an insulation value of about R21, for around twenty cents per square foot, and with the purchase of $50 or more of insulation, most retailers will give you free twenty four hour use of the machine that grinds and blows it out. Figure about a penny per R value, per square foot, including tax and blower usage. It is a fast and fairly easy job for two people. If you are doing it for your

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first time, you might want to start with just a dozen or so bags. After doing an attic, you will be qualified to consider taking on the job of using cellulose to blow into walls, should you ever be in a position to need to. Cellulose is made from recycled news and other papers, which have been treated with natural borax to be fire retardant. Cellulose is also mold and rot resistant. It is, by far, the most popular environmentally friendly insulation available. It has a long proven track record, and is easy to find, and instal.

Another insulation approach, which works well for reducing unwanted heat, and particularly well in attics, is what is referred to as 'radiant barriers.' This is basically using a layer of shiny metallic foil, that literally reflects back the heat, or does not radiate it away. Heat radiates as electro-magnetic waves, called infrared rays, just like the light we see does as visible light, only the wave lengths of heat/IR are too long for us to be able to see them with our eyes. Foil however, reflects visible light too. Aluminum foils have the potential to reflect up to about 97% of the heat, but due to dirt, dust, and other factors, the functional number may be down around 85%. Nonetheless, it works very well. Rather than saying that foil 'reflects heat,' as I did above, it is more accurate to say that it has a low "emissivity." That is like the "Low-E" surfaces, used on high R value windows. The emissivity of a surface is rated in relationship to the emissivity of a perfect emitter, also known as a 'perfect black body' and would have an emissivity value of 1. Therefore, emissivities of all surfaces in the real world must have a value of less than one, and can be expressed as a percentage of their ability to emit, compared to a perfect emitter. If you noticed an abundance of words related to emitting, instead of reflecting heat, then that was not wasted on you. Foil works equally well to insulate, whether it is the surface that is receiving or giving off the heat. It only needs to stay clean and dust-free, so facing upward will usually create a situation where a radiant barrier will lose most of its insulation value in a fairly short time, from dust fouling.

Radiant barriers are perhaps the most misunderstood, therefore potentially the most misused insulation there is. As I have mentioned before, and will continue to reemphasize, heat moves by three means, and only three means. Those are, briefly, by convection, which is in the movement of a warm fluid, such as air or water; by conduction, which is from molecule to molecule through a material that could be a solid, liquid or gas; and by radiation, which is how light gets here from the sun, and why we can feel the heat of a fire. Only one of those, convection, is effected by gravity. Radiation, and conduction happen in all directions equally, only following the general rule that heat moves toward cold. What does this have to do with understanding how to use radiant barriers? Well, to be effective, a radiant barrier needs to be a surface, not just an interface with another material, and to be a surface, it needs to be adjacent to a gap between it and something else. The gap is usually an air space, but could be filled with a different gas, or even a liquid, or theoretically, an insulating solid that is transparent to IR rays. The gap could also be a vacuum. In the case of a vacuum, direction and gravity would not matter because, as we have learned, gravity only effects convection and, without a fluid to move, there can be no convection. So the insulation value, and the effective R value of a radiant barrier is not only subject to, but is highly dependent on the way it works with its adjacent airspace.

The end result of this is that radiant barriers will have greatly different R values when used with different airspaces. The two main variables are the size of the airspace, and whether the heat is going up, down, or horizontally. When heat is moving upward, convection moves a lot of heat, so a radiant barrier will only make a small difference, of less than R1. In or on a wall, radiant barriers work much better, but there is still air movement in the gaps between, so it is only about as effective, in optimal multiple layers, as other wall cavity insulations. However, since there will always be air gaps with bat type insulations, such as fiberglass, and heat can actually radiate a little way between the fibers, a foil against fiberglass insulation can be expected to have a positive effect. Where radiant insulation really 'shines' (to use a heat transfer metaphor) is in its outstanding ability to reduce heat flow downward. This happens, because warm air does not convect down, so the air gap is a true dead air space. Due to the ultra low density of air, it is a very poor conductor of heat. With the convective heat transfer also reduced to zero, there is only radiation left. Since foil can reduce that drastically, very high insulation values can be achieved with only one simple low cost foil layer. It has often been conservatively stated that a radiant barrier on the underside of a roof, can increase the insulation value of an attic with R19 ceiling insulation, to R30. That is pretty effective. However, it must be noted that about the same improvement can be made by blowing in R11 fill insulation. And, whereas the radiant barrier will do almost nothing in winter, the fill insulation will improve the R19 by 58%, for winter as well as for summer. Since the R11 could be achieved with about eleven cent worth of DIY cellulose, let that be a guide for how much you are willing to spend on radiant barriers, instead of just blowing in more fill insulation.

Technically, radiant barriers can be any shiny metallic surface. The basic difference will be in the nature and durability of the base material the shiny surface is mounted on. Even standard kitchen foil can be used as radiant barriers, if they are used where they will not tear. There are heavy duty, and extra heavy duty foils available through commercial food service suppliers. They will run five to ten cent per square foot. Standard radiant barriers will typically cost ten to twenty cents per square foot. Remember, you can blow in cellulose insulation, that will work just as well in the summer, and will also work well in the winter, for only about eleven cents per square foot of attic 'floor' area. That converts to less that ten cent when compared to foil on a 6/12 pitch, and less than eight cents for a 12/12 pitched roof. There are situations where radiant barriers might be a definitive optimum solution, even in more northerly climates if a low cost foil can be located, but in general, in the north, it will be more cost effective, and less work to add cellulose, than radiant barriers.

Attic ventilation is also a much misunderstood subject. building codes vary, but usually suggest a minimum vent area of one square

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foot of unobstructed free-air vent, for every 300ft² of attic floor area. Research would suggest that when cooling is the major concern, that is far from adequate, and should be at least doubled. There are other attic venting/cooling strategies, which would increase that by many more times. In general, with an existing house, if your attic gets more than about twenty degrees (F) warmer than outdoors, then you could use more ventilation. There are a lot of vents for sale. Some can be very expensive and fancy, for solving problems that are simple and easy. In general, you can almost always ventilate your attic passively. If you have any desire to be energy efficient, do not buy any attic ventilator that uses electricity, even if that electricity comes from the sun. The simple fact that the attic is hot, means that it can be its own hot air moving machine, basically a Solar chimney. All you need to do is give it a chance, by opening up enough vent area, so it can flow. Passive roof vents, also called static vents, roof louvers, and sometimes referred to as 'J vents' come in a variety of sizes, shapes, and free-air vent capacities. They are sold at all building centers, lumber yards, and roofing suppliers. They are the round or square, metal or plastic vents, which you have often seen rising a few inches from the back roof of houses. They are seldom seen on the front. Regardless of their shape or size, a few things they all seem to have in common, is that they are low-cost, easy to install, and very effective.

Many, if not most older roofs never had proper low vents. For proper ventilation, it takes lower vents to draw in cool air at the same time the high vents are allowing the warm air to rise out. This is called the 'stack effect' and it requires height between the openings. Without height it will not flow. Often roofs have very adequate upper vents, and meet their code requirements, but do not vent, because of the lack of lower openings. If you have overhangs, and your attic is too hot, installing soffit vents may be your best investment. Ideally you should have about the same area of lower vents, that you have in upper vents. Installing soffit vents is a fairly easy job for the DIYer who doesn't mind working overhead. Also make sure that you have an equal ventilation area between your overhangs and the attic, so the air can move up from you soffit vents. If insulation is blocking the way, you can buy baffles to maintain a vent space between the insulation and roof, or you can make your own out of cardboard. A favorite trick of mine is to use a section of 4" black corrugated drain pipe which sells for under $3 for a ten foot section. It can be cut with strong scissors. Just make sure you install enough of it to create avent spaces that equal the area of your soffit and roof vents.

If your house has no overhangs, then you will need to look for other options. If you do not have gutters, there are special facia vents that do the same thing as soffit vents. If you have gables, you can install low vents in the wall, that will bring air in near the floor of the attic. If you have an addition, or lower connecting roof, its roof vents can function as intakes for higher exhausting roof vents in the main roof. The important thing is the difference in height. Only as a last resort, to overcome bad design in a house, should you turn to using electricity to ventilate your attic. There is almost always a better way. It is just a waste of energy.

An addition note, that I want to interject at this point is that though it is code to vent attics to outside, and in most cases it is an excellent idea, there is potential in very warm and humid climates, for this to cause condensation problems. This can happen when a house is air conditioned, especially with ducting in the attic. What happened is the warm humid outdoor air is brought into the attic, where it comes into contact with the cold surfaces of the ceiling and air conditioning ductwork, which condenses out its moisture, which then soaks an area of insulation, framing, and ceiling. This can contribute to a number of problems, even mold growth. . There is a remedy for this, which involves closing off the vents, insulating the underside of the roof with foam, and venting the attic to the house. This cools it with dry conditioned air, and the condensation potential disappears. This also meets code. If you are interested in learning more about that particular approach for hot/humid climate attics, you can read about it at www.buildingscience.com.

There is however, one important area where fans can do us a lot of good. That is in creating a breeze to directly cool our bodies, and to bring cooling breezes, and night air in to areas of the house which would not otherwise have much air movement. It is possible to design and build a house that will not need this, but it is generally too much to expect from an existing building. Modifications for achieving that much passive ventilation might make it easier to tear down and start all over. So, fans can be a good way to go. For the purpose of simplicity I will mention three basic types. One would be simple portable box and table fans, that can be placed, adjusted, moved, and set for personal cooling, within the limitations of temperature and humidity that were mentioned earlier. These fans create a breeze, but do not do any actual venting. A second group of fans set in windows and either bring in, or exhaust air from the house. Their primary purpose is venting. The third type, is the whole house vent fan. These mount through the ceiling, drawing the warmest house air up into the attic, drawing outside air in through the windows, and forcing air out the attic vents, at the same time. With this type of fan, the outdoor air could be drawn in through the basement, to also take advantage of the ground coupled coolth of that area of the house. There are many variations, but so much is subject matter for another month. Forgive me for all I have missed. We will be getting to it in future editions. Till then....stay cool!

Laren Corie
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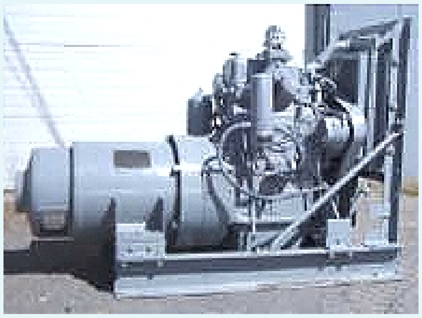

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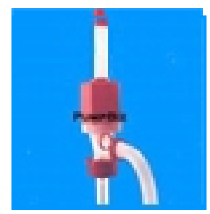

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