ENERGY SELF SUFFICIENCY NEWSLETTER

MARCH 2005

Off-Grid Living
Biofuels
Hydro
Solar
Wind

*** Electricity 101 * Biofuels - Biodiesel ***
*** Passive Solar - Cold & Cloudy? * Off-Grid Journal ***

A Rebel Wolf Energy Systems Publication

From The Editor's Laptop

by Larry D. Barr, Editor

I'm a member of quite a few Internet email groups for various facets of energy self-sufficiency and off-grid living. Although I spend quite a bit of time reading and, in many cases, responding to email, I don't begrudge a moment of that time. The interchange of ideas is always interesting and educational. There are times when a post, or a series of posts, will definitely make clear that there are as many concepts of off-grid living as there are folks who talk about it.

It seems that some folks consider off-grid living to be living without electricity and running water. Others would like to do it while still retaining the 42" plasma TV, the electrically heated hot tub, every kitchen appliance known to mankind and enough amps left over to run the electric SUV buffer. So, which one is really living off-grid?

In my opinion, if neither one is deriving their power from the local utility, they both are.We'll get into the discussion of total energy self-sufficiency in a minute.

Operationally, the only difference between the person living with no 'modern' conveniences and the guy with the luxury spread is that one of them spent more money to set up his off-grid home. Well, that and the fact that one of them is much more comfortable than the other. But remember that comfort is subjective.

So, is there a common definition of "off-grid" and, if so, what is it? To my way of thinking, if you're generating your own electricity from renewable sources, you're off-grid. That's based on the definition of the electrical distribution infrastructure as "the grid." But are you truly energy self-sufficient?

If we agree to not debate the usually hotly debated subject of embedded energy, the measure of how much energy of all kinds is involved in the manufacture of products, we can begin to creep up on a workable definition of energy self-sufficiency. Or can we?

To my way of thinking, if I have a propane tank sitting in my yard and I'm heating my water and cooking with propane, I might be off-grid but I'm not energy self-sufficient. So, I put in a solar water heater and build a methane digester (I have hypothetical cows, you know) and fuel my cooking stove with CH_4. Am I energy self sufficient now? You bet. No question about it. Or is there?

Well, there is that little matter of the vehicle sitting in front of my energy self-sufficient house. It's a (hypothetical) VW Jetta wagon with a turbo-diesel in it and gets 50 highway miles to the gallon. But I buy my fuel at the pump in town. Hmmm. Guess I'm not truly energy self-sufficient.

So, I make friends with the folks at the local Golden Arches and get a source of free used fry oil, from which I make biodiesel to fuel my ride. OK, I've got it dialed in now. I'm energy self-sufficient. I even run my car on renewable fuel. Just like Daryl Hannah.

All right, I've done it. I've become energy self-sufficient. Let's run the checklist. I'll prove it to you.

Electricity generation: wind and PV. Water pumping: 12 VDC from the renewable system. Water heating: solar. Cooking: methane (from the hypothetical cows, remember?) Vehicle: biodiesel. Space heating: wood, of course. I cut every piece with my chain saw and split it with my hydraulic wood splitter.

"Say what?" you scream in outrage and indignation. "You've led me to believe that you're energy self-sufficient and yet you're using dino-fuel to cut and split your wood? What kind of fool do you take me for?"

Oops. Guess I missed something.

So, what have we accomplished with this little exercise, hypothetical though it may be? As far as I'm concerned, if we can decide that there are, in fact, varying degrees of energy self-sufficiency, I'll be happy.

The simple fact is that being truly and completely energy self-sufficient involves more than mounting a couple of PV panels and hoisting a wind generator. There are a lot more things to consider in our quest for energy self-sufficiency than just our source of electricity.

The important thing, I believe, is to take the first step. Off-grid living is a great beginning to total energy self-sufficiency and the first step to living lightly on Mother Earth. And that must be our ultimate goal. ldb

We Tried Something Different This Month

For the first two editions of this publication, our body copy was set in 12 point Times New Roman, like you're reading now. Nobody complained about the typeface, but we got a few comments about the amount of scrolling that's required to read the magazine on-screen. The human eye tends to favor shorter lines, so the two-column format is really more reader friendly. But just to get a little more copy on each page and minimize the scrolling for those who save a tree and don't print out ESSN, we made one small change this month.

We went to 10 point Times New Roman, like this. It's pretty much the same type size that many major newspapers use, and some magazines even use 9 point type. Take a close look at it, compare it for eye-friendliness and ease of readability with our first two issues and let us know what you think. We're openminded and want you to enjoy the reading time you spend with ESSN each month. So help us make it easy for you. Tell us which you prefer. ldb

Why you NEED a Velomobile

By Bryan J. Ball

In my adult life there have been a few material things I acquired that had immediate and irreversible affects on my daily life. Things that almost instantly made me wonder how the hell I ever got by without them. My first Internet connection, my first PDA, my first cell phone... All of these were things that changed my life forever within two weeks of their arrival. It didn't even take that long for the virtues of my first velomobile to sink in.

For those of you who do not know exactly what a velomobile is, let me explain. A velomobile is a fully faired human powered recumbent tricycle (usually... there have been a few two-wheelers that never made it beyond the prototype stage) that is fully faired and designed for daily use in any weather. Most have some internal storage space and full suspension is common. The modern velomobile originated in Europe and a vast majority of them are produced and used on that continent (The Netherlands has the most). Velomobiles aren't particularly light (60-75 pounds is average) but they are very aerodynamic and in the right terrain, they can be much faster than a bicycle.

As near as I can tell, the word "velomobile" originated in France. Some of the first velomobiles were made by the Velocar company in France in the 1930's. These early Velocar velomobiles were four wheelers and quite heavy. Velocar is the same company that produced some of the first production recumbent bicycles. In 1934, a rider broke the one hour speed record on one of their bicycles and recumbents were subsequently banned from bicycle racing by the Union Cycliste Internationale.

I acquired my first Velomobile (the shiny new Cab-Bike featured in several of these pictures) at perhaps the perfect time... early December... in Europe. I'm from upstate New York and consider myself to be a rather hardy soul when it comes to cold weather. I've gone through month-long stretches where the temperature never cracked zero degrees Fahrenheit with barely a shiver. But the cold in central Europe is something all together different. It rarely gets below plus twenty or so on the Fahrenheit scale but the air is VERY damp. The moisture contained in the perpetual European winter fog is downright bone-chilling. It can penetrate the warmest material that any clothing manufacturer could dream up in an instant. Throw in a few steep descents and the frigid winds that accompany them and you have a rather unpleasant bicycle commute.

I tried to suck it up over the winter of 2003/2004 and I did manage to ride into work often enough that my co-workers began to question my sanity, but I still was off the bike enough that my physical and mental health suffered a bit. Over those months, I spent a rather large amount of time on the Internet shopping for a Velomobile. At every major bike show I attended I spent more time around the booths of companies like Leitra, Cab-Bike, Flevobike, Aerorider and Velomobiel.nl than I did anywhere else. After scoring a few test rides, I was smitten. I knew that I must have one before I the next winter season set in. I almost made it... The first snow fell about a month before I picked up the Cab-Bike.

In October of 2004, I attended the annual German Velomobile meeting near Giessen, Germany. By this point, I already knew that a velomobile was in my very near future. I was vacillating between ordering new or buying used. I got to see and ride a few more machines but I was also glad to find out that I liked the people that rode them. The vast majority of the crowd was made up of mild-mannered, forward-thinking, extremely inventive individuals. Many of them are not your average recumbent riders. Most of them don't really even seem to consider themselves to be recumbent riders at all. (Frederik Van De Walle wrote a very interesting thesis on this subject earlier this year. It's available in the links at the end of this article.) Many of them are very interested in speed but most of them are also very much interested in making their vehicles more practical.

It's only taken me a couple of weeks to start looking at my velomobile the same way. I love the fact that it doesn't take me much longer to get to work every morning (despite the Cab-Bike's weight and my very velomobile-unfriendly hilly commute) but I like the fact that I can ride in comfort when it's only minus eight degrees Celsius or pouring rain even more.

I've also quickly realized that you need to make a slight adjustment in thinking if you're a cyclist considering a velomobile. It's not a bike or even really a trike. A velomobile is a human powered vehicle. They still have all of the usual bicycle parts (pedals, a chain, bicycle tires and wheels) but the experience of riding a velomobile is much different than riding anything else. They weigh a fair amount so they don't climb particularly well, but on flat terrain they really fly. Basically the same performance characteristics as many other recumbents but on velomobile they're just amplified. Most have full suspension so you're fairly isolated from bumps and road imperfections. Fully enclosed models like the Cab-Bike and the Leitra also leave you fairly well isolated from the rest of the outside world so may not be the best choice if you like to ride in groups.

This is definitely not to say that they are any less fun than a bicycle. In many ways they may be more fun. The speeds that you can maintain under your own steam while traveling on level ground are always quite pleasing. Commuting to work in almost any weather without the aid of any fossil fuels is also very satisfying.

The primary thing that keeps most people away from velomobiles is the cost. You can purchase a very nice used car for the price of the average new velomobile. I can vouch from personal experience that money should not be a limiting factor. My Cab-Bike with options cost me about 5600 Euro (about $7200). But after all is said and done I will have only paid about 2000 Euro out of my pocket and I raised that money by selling my now obsolete second car. Since velomobiles draw so much attention, the rest of it is

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Velomobile . . .cont.

easily paid for with advertising. If I didn't want to keep the prime spaces for myself, I could have easily paid for the whole thing with ads without selling the car. Driving a billboard might not be for everyone but it sure beats the heck out of paying full price! Of course there's also the money saved by not burning gas, not paying for car maintenence or insurance and the money you'll save on doctor bills due to your increased fitness to take into account. You also don't have to buy things like fenders or racks or panniers. Even the most impractical velomobiles have enough storage space for a small load of groceries or a weekend's worth of camping gear.

There is the possibility of building your own. There is of course the crude but effective choroplast route of you're particularly handy. And if you don't want to do all of the work yourself, Gabe Devault of Easy Racers is working on a fairing kit tentatively called "The Pod". He's currently fitting it to a Sun EZ Tadpole but the idea is to make it adaptable to a wide range of touring trikes. VelomobileUSA has also obtained a license to build the Alleweder (in the original Flevobike flavor and the newer Alligt version) and they have made it available in a kit at a reduced cost. If you don't want to buy a recumbent trike to use a platform, Greenspeed and Hellbent offer plans for their trikes.

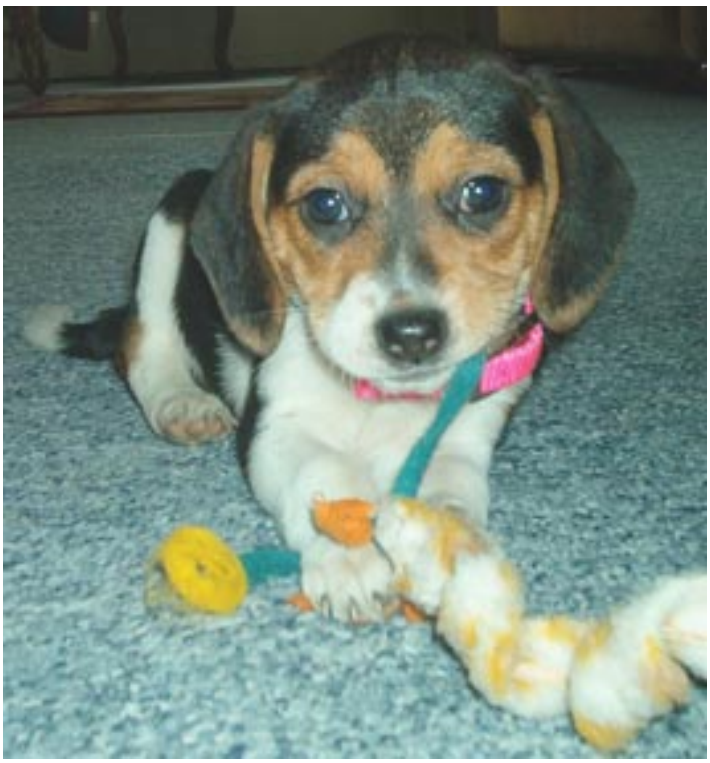
You'll probably noticed that most of the companies I've linked to below are based in Europe. America is one of the largest consumer markets in the world but has so far not largely embraced the velomobile concept. The falling dollar and astronomical shipping costs have really hurt this small segment of the community. American liability standards also make it difficult for these small manufacturers to afford the insurance needed to export their vehicles in a conventional manner. It's not at all impossible for someone to import a single velomobile on their own and many have. But at least for now, it looks like North Americans are on their own if they want to see velomobiles on the road for a reasonable cost or in any large number. Thankfully there are a handful of companies looking to improve the situation.

Nimbus Kayaks is well into the prototype stages of a very nice delta velomobile. The prototype rides on a Hase Ketteweisel chassis but it appears that the production version will be a monocoque design. Maybe enough e-mails can get them to keep the molds for the Kette fairing handy. Reg Rodaro is another Canadian who has been slaving away at the velomobile concept for many years. His Stormy Weather one-offs look more and more refined every time I see them. And of course there is also the VelomobileUSA Alleweder project that I mentioned earlier. The Alleweder is certainly the most proven and widely used velomobile in the world and its addition to the US market at a reasonable price can only be a good thing.

Many non-cyclists are scared away from a human powered vehicle because they don't believe that they have the fitness level required to operate it. While its true that if you've been a couch potato for the last twenty years, you're going to have a very hard time getting around in a 60 pound velomobile, you shouldn't totally give up on the concept. As I said in my last ESSN, article... It takes a long time to get into really good cycling shape but getting into pretty average cycling shape doesn't take nearly as long as you would think.

Many cyclists buy a velomobile thinking that it will make them faster. In the right terrain and conditions this is definitely true. But if you live in the hills this may not be the case. Above ten mph or so it at least feels like the aerodynamics are helping you but if you're grinding your way up a long slow grade you're basically just pedaling seventy pounds worth of trike. On my rolling hill commute the Cab-Bike is as fast as most recumbent bicycles but definitely not any faster. Something like a Quest would probably have a bit of an edge. However, if you live in the Netherlands or Kansas or Florida a velomobile is probably going to make you very happy.

That about sums up my case for owning a velomobile. The cost is high, but fairly easy to offset. And you can always build your own... They're not always faster but they often are. More importantly, they let you get where you need to go in almost any weather in relative comfort without burning any gas or paying for any car insurance. What can be better than that?



What does this picture have to do with renewable energy? Not a darn thing! How's that for an honest answer? It's just that I needed to fill a little space at the bottom of this column and "Missy", the new addition to the Steve Spence homestead, was too cute to resist. Of course, if this was your ad, folks would be reading your message and calling you instead of just thinking how lucky Steve is to have such a cute pup.

Electricity 101

Loads, Wires and Connectors

by Larry D. Barr and Steve Spence

Last month we discussed a lot of the theoretical issues relating to electricity. This month, we'll get a bit more practical and get you hands-on with something besides your calculator. We'll be talking about how to figure out what kind of load a particular device is drawing, what size wire it requires and how to make safe, secure connections. We'll also take a look at circuit protection devices, and how they're used.

First, let's tackle the ways to determine the current draw of a given load device, since that's essential to selecting the right size of conductor for it. There are a variety of ways to get the load figure, and I'll tell you my favorite one first. Read it off the label on the unit! On a DC powered device, the amp draw is listed, on an AC powered unit, most times the watts are given. If amps are listed, you're done. If it's watts, you have to use a bit of what you learned here last month. Watts, or power, is the product of the voltage and the current. The formula for that is P=E*I. Since we need I, the formula becomes I=P/E.

Let's do one just for practice, OK? The label on your 120 VAC toaster oven says 1450 watts. Substituting the numbers into the equation yields I=1450/120. Therefore, I, the current draw in amps equals 12.083. Easy enough. You remembered that from last month, right? Good job.

What if there's no rating plate or label on the device? No problem, just do a bit of measuring. There are several meters available for current measurements. One of my favorites for AC circuits is the "clamp-on" type shown in Photo 1. Just clamp it around the hot wire of a circuit and read the current directly from the scale. It's shown with an adapter I built to facilitate measurements of cord connected appliances. The amp measurement is what you're looking for, so there are no calculations to do.

Photo 1

Another neat AC measuring device is the "Kill-A-Watt." By simply plugging it into the wall recep and plugging the load into it, you can measure several parameters. Voltage, current draw, line frequency, power factor, watts, volt-amps and kilowatthours can all be displayed at the touch of a button. The one shown below is displaying the line frequency of Steve's VeggieGen.

Photo 2

Direct current measurements are similar, but require different meters. Inductive meters are available from automotive supply vendors such as NAPA, Mac or Snap-On. All you do is hold them against the wire, and read the measurement directly from the meter scale. As with most things, you get what you pay for and accuracy improves with price.

Photo 3

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Electricity 101, continued . . .

Most volt-ohm-milliammeters (VOMs) have some DC current capabilities, of varying ranges. Photo 4 shows my venerable Simpson 260 analog VOM. The maximum current the unit will measure is 10 amperes. Do NOT exceed that or things happen that are very expensive to repair. The 10A range on the 260 isn't internally fused, so don't exceed it. Break the circuit on the ground side and connect the positive (red) lead to the side closest to the load and the negative (black) lead to the side closest to the battery. Be sure to connect the leads with the proper polarity, or it gets expensive again. Be sure to know and respect the limits of your measuring device.

Photo 4

Measuring high DC currents is generally done with a shunt. A shunt is simply a resistor of extremely low value which is inserted in series with a circuit. The voltage drop across the shunt is directly proportional to the current flowing through the load, and is measured with a voltmeter calibrated in amps. It may sound a bit complicated, but you don't really have to fully understand the theory in order to use the equipment. Photo 5 show a shunt which can be used with either a digital or analog meter of the proper range and calibration.

A new and exciting device for DC measurements is the Digital Power Analyzer, produced by Medusa Research (Photo 6). The DPA measures voltage, current, power, amp-hours and watt-hours. All the parameters are displayed on-screen continuously, except for amp-hours and watt-hours, which alternate every 3 seconds. This unit is great for tallying the draw of an appliance, such as a DC fridge, over time. Some


Photo 5

models come with computer logging software and a serial cable for connection to your computer. Definitely an ideal combination for logging the charge put into a battery bank by a PV panel or a wind generator over a period of time. The absolute operating limits of the DPA are 60 volts and 100 amps. That covers most DC electrical measuring required in the average renewable energy system.

Photo 6

All right! You've determined the amperage consumed by your load, now how do you determine the correct (that means safe) wire size to carry the voltage to it? Simple, just use an ampacity table, such as the one available for download at Rebel Wolf Online. They are very easy to use. All you do is find where the amp draw of the load and the length of the circuit intersect on the chart, and that's the wire gauge you use.

The reason that the length of the circuit comes into play is the fact that the wire has a certain amount of resistance (measured in ohms/foot). And resistance, as we know, is an impediment to the flow of the current to the load. In a long wire run, the conductor resistance offers so much impediment to the current flow that the voltage at the load is reduced. This is called "voltage drop" and we must use a larger wire size to minimize it. There are tables that list the resistance per foot of the various wire sizes and you can calculate the voltage drop for any given load and length of run. But, if you just use the ampacity chart, you don't have to do any of the calcs.

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Electricity 101, continued . . .

The most important device in any electrical circuit isn't the battery or other power source, not the load be it a lamp or a computer, it's not even the wire between the two. It is the circuit protection device, a fuse or circuit breaker. What makes a fuse, a lowly fuse, the most important device in an electrical circuit? Very simple, it's the device that is responsible for interrupting the flow of electricity in the event of an overload, and thereby preventing a possible fire or other damage. Since it's that vital, it'd be good to know how to select the right one. So, let's find out how to do just that.

In AC wiring at household voltages (120/240), the National Electrical Code (NEC) specifies very clearly the maximum amp rating of the circuit protection device for each size and type of conductor. For example, 12 AWG THHN wire requires a 20 amp breaker, while 10 AWG gets a 30 amp. All very simple, and derived from a chart in the back of the book. This works out very well for the 120 VAC receptacles that line the walls of our homes and for any other loads we may encounter in an AC system.

However, there is no handy chart in the back of the book for low voltage DC wiring. So how do you select the proper circuit breaker? Easy – and safe, pick a maximum load for the circuit and size the conductor for the maximum length of run. If you're running a circuit for some 12VDC convenience receps in a room, size the wire for the intended load at the most distant recep. Let's say you've decided this will be a 15 amp circuit, and the distance from the distribution panel to the farthest recep is 25 feet. Multiply that distance by 2 since you have a ground wire returning. That's a total circuit run of 50 feet and the chart calls for a 10 AWG conductor. Use a 15 amp circuit breaker with a long delay or a slow-blow 15A fuse.

If you're using cigarette lighter plugs and receptacles, you have my sympathy. They suck. However, many 12VDC appliances are supplied with them and many times folks are hesitant to cut them off and replace them with a decent connector. If that's your choice, just remember that most lighter plugs/receps aren't rated for the full capacity of your circuit. Some are rated as low as 3 amps. So, don't ever exceed the rating of your connector, regardless of the ampacity of your circuit.

I was taught that if you're not part of the solution, you're part of the problem – and I just told you that lighter plugs are garbage, right? Do I have a solution? You bet. Anderson PowerPole connectors. These nifty little connectors are the ultimate solution to all of your DC interconnection requirements. Photo 7 shows a few applications of the PowerPoles. All the ampacities from 15 to 45 amps use the same connector housing with the only difference being the contacts. They're inexpensive, and they're reliable. What more could you want? They're also mandated by the ARES, which is the Amateur Radio Emergency Service. These connectors should be adopted by the RE community as well. There are too many different connectors used for DC circuits in off-grid homes and we should adopt the PowerPoles as the standard for 12VDC circuits in off-grid homes and systems.

Photo 7

Just remember one thing. Using PowerPole connectors does not relieve you of the necessity of remaining within the capacity of your circuit. For example, in that 15 amp circuit we just ran – just because you've installed 4 of the 15 amp PowerPoles around your walls does not mean you have a 60 amp circuit. You have, since you're limited by the ampacity of your wire and your breaker, a 15 amp circuit that will supply only a total of, yep, 15 amps. Oh, one more thing. I highly recommend PowerWerx as a vendor of all things related to the PowerPole connectors. Great vendor. Instant service and great prices.

Now, let's talk for a minute about the proper way to make connections. All the planning and calculations in the world won't do any good in your system if the connections are substandard. So, let's learn how to do it right. We'll demonstrate by making a connection to a terminal for an Anderson PowerPole. But the principles apply to all connections.

For many years it was taught that soldering was the only way to make a proper connection and that crimp terminals were an inferior product and should only be used in emergency repair situations. And for many years a lot of us used

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Electricity 101, continued . . .

the "belt and suspenders" approach to our connections. After we crimped the connector on the wire, we soldered it too. Crimp connectors and tooling have improved and now it's no longer necessary to solder a well-made crimp connection. You may if you wish, but you don't have to. Here's how to make a good crimp connection.

First, strip the insulation from the wire for a distance equal to the wire cavity in the connector. You want to fill the cavity, but you don't want any bare wire hanging out on either end. Next, place the conductor inside the terminal and crimp solidly. That was easy, wasn't it? Use a proper crimping tool. You can't do a good job with a simple pair of pliers and all you'll do is ruin a terminal if you try to use wire cutters. See Photo 8 for a step by step progression of making up a contact for an Anderson PowerPole.

Working from left to right, you'll see the proper strip length for the connector on one lead. An uncrimped contact is on the other. Note that no bare wire is exposed. Looking at the crimping tool, there is a rounded side of the die cavity and a side with a protrusion. The contact must be oriented in the die so that the slit is to the rounded side. If you do it the other way, you'll deform the connector and the connection will be worthless. The right side of the picture shows a properly crimped contact and a finished PowerPole connector.

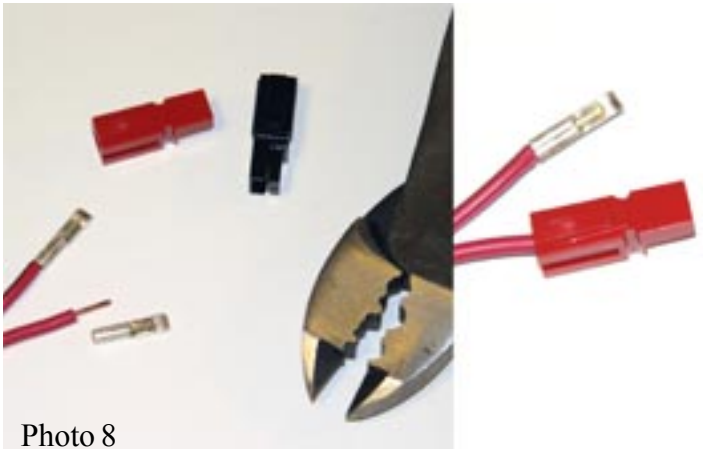

Photo 8

We've covered a fair amount of territory in this installment of Electricity 101, but it's all essential for you to be able to wire your off-grid home. Study this well and learn it solidly. You'll be needing it. We'll be back next month with information on the sizing, care and feeding of your battery bank. See you then.

Gear Tip

Unless you're a real "techno-geek" (I am, so I can say that), it's probably better for general use around the homestead to buy a Digital MultiMeter (DMM) rather than an expensive analog meter likethe Simpson 260 mentioned in Electricity 101. Overall, DMMs are easier to use and are much less fragile. In many cases, they are also more accurate.

DMMs are inexpensive and reliable. You can buy one for the house, one for the battery shed and one for the car and still get change back from a twenty in some cases. Like everything else, you get what you pay for and while the $4.95 unit is fine for basic measurements, you'll want to spend a bit more money for the one on the bench. Your main DMM should have 'auto-ranging,' meaning that it automatically selects the proper settings for the voltage or current applied to it.

Take your time and look around when buying tools. You'll have to live with them for a long time and you want to make sure that they "fit your hand." ldb

It's Too Cold And Cloudy For Solar . . . **Not!**

by Laren Corie

It seems I wouldn't even need Solar, if I had a BTU for every time I've heard someone say; "Well, I'm sure it works fine out west, or down south, but we don't get any sun here, during the winter." To that I usually reply; "I agree that it can get very cold and cloudy, but even if we got nothing from Solar the whole winter, which is not the case, we still have an autumn AND a spring, that are like the winter in Virginia, so Solar heating gets to work at least TWICE as long for us here in the north, as it would there, and that means a quicker payback on our investment."

I have long forgotten why I chose Virginia, but I believe it was just an instinctual statement, that I never verified with any real world numbers. It sure sounds good, but does it really reflect the situation accurately? To find out, let's take a look at the monthly weather statistics in the Solar Resource Information, from the Renewable Resource Data Center, of the National Renewable Energy Library (NREL), at http://rredc.nrel.gov/solar/ Since they store weather data, based on monthly figures, I have 'rounded' the seasons to their nearest months. This is not really about absolute accuracy, anyways, just the general veracity of the statement, and what it means about the viability of Solar space heating in your climate.

The 'cold' of an area is measured in Heating Degree-Days (HDD). Here is the definition of a Heating Degree-Days, according to the New York State Energy Research and Development Authority

" Definition: Degree-days are relative measurements of outdoor air temperature used as an index for heating and cooling energy requirements. Heating degree-days are the number of degrees that the daily average temperature falls below 65° F. Cooling degree-days are the number of degrees that the daily average temperature rises above 65° F. The daily average temperature is the mean of the maximum and minimum temperatures in a 24-hour period. For example, a weather station recording an average daily temperature of 40° F would report 25 heating degree-days for that day (and 0 cooling degree-days). If a weather station recorded an average daily temperature of 78° F, cooling degree-days for that station would be 13 (and 0 heating degree days). "

ALPENA, MICHIGAN Annual Total HDD 8284

Autumn		Winter		Spring		Summer	
Oct	561	Jan	1469	Apr	723	July	43
Nov	879	Feb	1308	May	411	Aug	80
Dec	1280	Mar	1147	June	146	Sept	237
Total	2720		3924		1280		360

NORFOLK, VIRGINIA Annual Total HDD 3495

Autumn		Winter		Spring		Summer	
Oct	164	Jan	803	Apr	249	July	0
Nov	380	Feb	672	May	51	Aug	0
Dec	657	Mar	508	June	0	Sept	11
Total	1201		1983		300		11

Now let's compare the HDDs for the two cities.

	Autumn	Winter	Spring	Summer
Alpena	2720	3924	1280	360
Norfolk	1201	1983	300	11

Alpena Spring/Autumn seasonal average 2000 HDD
Norfolk winter 1983 HDD

Well there it is. Though these numbers are based on monthly data, and the seasons officially begin and end on solstices and equinoxes, that only represents a variation of a few days. So, that basically backs the point of my statement, that Michigan has both a Spring and an Autumn, that are similar in temperature to a Virginia Winter.

Now let's look a little deeper, at the available sunlight

Available Aver Solar Energy on South Facing Vertical Surfaces. (BTU/ft² per day)

ALPENA

Autumn		Winter		Spring		Summer	
Oct	920	Jan	810	Apr	1030	July	930
Nov	650	Feb	1040	May	940	Aug	1000
Dec	590	Mar	1160	June	880	Sept	1020
Total	720		1003		950		683

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It's Too Cold . . . cont.

NORFOLK

Autumn		Winter		Spring		Summer	
Oct	1160	Jan	1080	Apr	950	July	740
Nov	1140	Feb	1140	May	790	Aug	880
Dec	1040	Mar	1090	June	720	Sept	1030
Total	1113		1103		820		883

Comparison

	Autumn	Winter	Spring	Summer
Alpena	720	1003	950	683
Norfolk	1113	1103	820	883

Alpena Spring/Autumn average sunlight: 835 BTU/ft² per day
Norfolk Winter average sunlight: 1103 BTU/ft² per day

Alpena averages 24% less sunlight during its Autumn and Spring, than Norfolk's winter. This is primarily the result of the "Lake Effect" of the Great Lakes, which is not a factor in most of the north. Alpena is right on Lake Huron and is very cloudy until the lake either freezes, or at least cools down. As you can see, only the Autumn is cloudy. The Alpena's winter is almost as sunny as Norfolk's, and its northern Spring is actually 16% sunnier. Norfolk's Spring is milder than Alpena's Summer, and its Autumn is milder than Alpena's Spring.

On top of this, Alpena also has a winter, which represents 3924 HDDs. That is 12% more heating need, just in the winter months, than Norfolk's full year 3495 HDDs. During that time, Alpena receives 1003BTU/ft² per day (average) of sunshine on its south walls, which is more than it receives in either Spring or Autumn, due to the low sun angles which very effectively penetrate the south facing windows.

The point of this long display of statistics, is simply that Solar space heating needs cold weather in order for it to be useful and cost effective, not the other way around, as many people tend to think.. This factor is so important, that even in one of the cloudiest climates in the nation, the cost-effectiveness is very good, because the heating season is long, and reach far beyond those few cloudy months.. If the climate is also very cold, then a larger Solar space heating system can be cost-effective, and save even more.

This is not intended to discourage anyone in the south from getting on the Solar thermal band wagon, but system cost-effectiveness should be a careful consideration. You probably should first consider a water heating system, which will work for you twelve months of the year, before a space-heating-only system, that can only collect useful heat, for less than half the year.

May your winter days be bright.
-Laren Corie-

Ahead In ESSN
A Look to the Future

Just to give you something to look forward toin our upcoming issues, here's a sneak preview of what we'll have in the next few months.

Next month Maria (girl Mark) Alovert will describe the process of making text batches of biodiesel. Successful testing isthe first step to successful biodiesel production. Don't miss it.

We'll have a how-to article on building an LED task lamp for reading, close work or whatever. The light will operate on 12VDC and we'll have the article in the publication as soon as I can finish the lamp.

I'm also looking forward to resuming work on the urban off-grid project at my house. Between some inclement weather here and a really busy bunch of weekends at the planetarium, the project's been on hold for a couple of months and I'm looking forward to getting back to work on it.

Steve Spence will be back with the VeggieGen project as soon as the weather breaks in NY and Laren Corie has promised to do an in-depth comparison of high and low thermal mass construction here soon. Also, next month, Mike Nixon begins his ethanol series. Please join us. ldb

Introduction to Biodiesel

by Maria 'Mark' Alovert

In our first two issues, ESSN presented two biofuels with much promise for do-it-yourself energy self-sufficiency- methane digester and straight vegetable oil (SVO) technologies. In this and future articles, I'll be introducing you to another biofuel- biodiesel, an ester formed from vegetable oil or animal fat reacted with various alcohols. The simple biodiesel reaction creates a clean-burning "diesel" fuel which works with no engine modifications in any diesel engine. Biodiesel can also replace petroleum in many forms of home heating oil equipment. Biodiesel is produced on a commercial level worldwide, and can even be made easily in a backyard or farm setting. In keeping with ESSN's focus on energy self-sufficiency, I'll be presenting the do-it-yourself outlook on biodiesel production in these articles.

In Issue 1, Steve Spence introduced us to the VeggieGen, a modified generator powered by "straight vegetable oil". It is easy to get confused by the two related technologies. In contrast to biodiesel, an "SVO" application involves modifying a diesels fuel system so that thick raw vegetable oil is heated to 'thin it out' to a consistency resembling diesel fuel. The engine can then handle this thinned, hot vegetable oil in a manner similar to diesel. In an SVO application, the driver usually has to start the vehicle on petroleum diesel or biodiesel, and 'flush' the fuel system with petroleum diesel (via a selector switch on the dash) before shutting down. There are a few ways in which this technology is still considered experimental, however, which drives some people to focusing on do-it-yourself biodiesel rather than SVO conversion.

Biodiesel is the other vegetable oil alternative fuel technology of note, and it produces a fuel that requires no vehicle/engine modifications, and no changes to driving habits. Biodiesel is made from vegetable oil by chemically reacting the thick vegetable oil with an alcohol, usually methanol. The chemical reaction lowers the viscosity (thickness) of the oil to a consistency very close to that of diesel fuel, and removes the glycerol portion of the vegetable oil, which is thought to be a potential pollutant if burned in less-than-ideal circumstances. The glycerol forms a byproduct, which can be used in various applications (soap, or as a molasses replacement for cattle feed).

Commercial biodiesel has millions of tested on-road miles under it's belt. Many fleets use biodiesel to meet mandated emissions reductions. Shown here at last year's local "Biodiesel Car Show", the City of Berkeley, Ca, uses 100% biodiesel in it's municipal fleet, achieving cleaner exhaust without the expensive conversions that would have been required to use compressed natural gas or another emissions reduction strategy.

One of the advantages of biodiesel over SVO is reliability- there are no serious fuel system modifications that can create a point of failure- and another is that from an equipment cost perspective, biodiesel home production can be well-suited to people with multiple vehicles without the associated capital equipment cost of 'converting' each vehicle. People with multiple cars, or who use tractors and other equipment, can fuel their 'fleet' from a single home biodiesel production system. In some cases this can be cheaper than the expense of SVO conversions for multiple cars, even with the increased ongoing cost of fuel ingredients. The possibility of many users utilizing just one 'processor' has also led a number of Americans to start biodiesel homebrewing clubs, or co-ops. These will be a topic of a future article in the biodiesel series at ESSN.

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Intro to Biodiesel . . . cont.

In both the case of biodiesel and that of straight vegetable oil, the result is a 'thin' vegetable oil fuel that acts just like diesel- with a few (good) exceptions. Both are nontoxic and from a fire safety standpoint are very safe fuels to store. Biodiesel's emissions have been well-studied and generally there are very significant reductions in the harmful pollutants that diesels are normally responsible for. Emissions controls that are slated to become available on new vehicles in the US after 2006 will clean up any remaining emissions issues on biofueled diesels, making some diesels superior to hybrid-electric vehicles on emissions.

Additionally, and most importantly, both biodiesel or SVO are renewable- SVO a little more so than biodiesel, unless something's wrong with the SVO conversion and you're using a lot of diesel startup fuel (the easy-to-fix SVO 'short trip problem'). The carbon that is released during biodiesel fuel use becomes part of what's called a 'closed carbon cycle'- rather than releasing long-sequestered 'fossil' carbon as is done when we burn fossil fuels, biofuels release only as much carbon as was used by the plants that created the biofuel. Our atmosphere can handle this non-fossil carbon safely, unlike the overload created by the carbon liberated during the burning of fossil fuels.

Both biodiesel and SVO contain a positive energy balance- meaning that more energy is contained in a gallon of biodiesel or straight vegetable oil than went into creating it. And both technologies allow use of inedible fats and oils- ranging from waste restaurant fryer oil, to 'trap grease' or sewer grease, to many oil-bearing crops which produce inedible oils but have other useful co-products (like animal feed) or positive benefits (such as erosion control). Biodiesel allows use of more marginal waste fats than SVO- everything from rotten sewer grease to the fats collected from slaughterhouse wastewater can be turned into biodiesel if the process is done carefully enough.

Biodiesel has a number of advantages over diesel- better lubricity, which prolongs the life of fuel systems, better emissions, and renewability. However, it can be mixed with diesel in any proportion, meaning that when you run out of biodiesel on a trip, you can just add diesel as needed until you can find another supply of the good stuff. For those who store diesel fuel on-farm or use a fuel tank for an off-road use, there's more good news- biodiesel is classified as 'nontoxic' by the EPA and is considered nonflammable by fire classifications, which makes it supremely safe to store and handle. While the biodiesel production process requires an attention to fire safety, the finished fuel itself is difficult to set biodiesel on fire outside of engine conditions.

Biodiesel also has a couple of disadvantages- it gels at an inconveniently higher temperature, and it cleans out old diesel sludge out of fuel systems- which can mean changing a few filters in the beginning of biodiesel use, needed because the fuel system sends these loosened old petrodiesel deposits to the filters.

Optionally, a cheap gasoline prefilter such as this one, can help extend the life of more expensive 'stock' fuel filters on your older vehicle when first switching to biodiesel usage

The cold weather issues can be remedied by either running some (or even 100%) diesel in wintertime, or using some of the diesel anti-gelling technologies- fuel heaters, block heaters, strong batteries, antigel additives, and more. Luckily, there's a biodiesel industry focus on solving the 'cold weather' problem, and there are a few additives under development which are going to help with cold weather performance of the fuel in the near future. Some folks are managing to use B100 in New England (using fuel heaters and the like), and the problems are surmountable. The best resource for do-it-yourself solutions is the cold weather biodiesel discussion forums at www.forums.biodieselnow.com . Another surmountable disadvantage of biodiesel use is that the fuel attacks some rubber and plastic compounds. The problems are usually limited to older vehicles and their injector spillover lines- a very cheap fix- and experience has not shown these problems to compromise injector pumps or internal fuel system parts. Replacement spillover lines made of Viton brand synthetic rubber tubing can be purchased through McMaster.com and some biodiesel vendors. You will need to know the diameter of your fuel line to order from McMaster.com.

Biodiesel can be bought commercially, although at the present time the cost is quite high, without the same subsidies that petroleum fuels enjoy. This is where the homebrew version comes in, for many users- it can also be made at home from free waste restaurant fryer oil and about 50 cents a gallon of chemical ingredients. There's a flourishing community of people worldwide which has sprung up around the hobby of biodiesel 'brewing', and the technology for doing so is getting better daily.

Continued on Next Page

Intro to Biodiesel . . . cont.

In the US, a lot of 'biofuel groups' or biodiesel co-ops have sprung up for the purpose of promoting the fuel, and some of them include group homebrewing and attempts at community-owned biodiesel production. Outside of that, there is a huge online community built around biodiesel homebrewing information- and people on the 'forums' are quite willing to answer questions and to help beginners troubleshoot their new biodiesel experiments. Welcome!

Biodiesel Resources

Biodiesel Homebrew Guide- everything you need to know to make quality alternative diesel fuel from waste restaurant fryer oil , by Maria 'Mark' Alovert, $15 by mail through:
http://www.localb100.com/book.html

http://www.localb100.com/testbatch
In-depth visual guide to the process of making a test batch of biodiesel. The process will also be fully described in Mark's article next month in ESSN.

http://biodiesel.infopop.cc
This is the best biodiesel homebrewing discussion forum on the internet. Ask me questions about this article there!

http://www.veggieavenger.com/media
This forum is an equipment plans gallery- learn to build a simple biodiesel processor

http://www.localb100.com
More links and details about biodiesel

http://www.biodieselnow.com
An even better forum on biodiesel policy and activism

http://www.groups.yahoo.com/group/biodieselbasics
This is an email-based biodiesel discussion, for those who prefer lists to forums. Please feel free to discuss this article here!

http://www.green-trust.org
Excellent discussion forums on biofuels and most other topics related to off-grid living and energy self sufficiency.

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Meet The Writer

I discovered diesel engines quite by accident. I wanted a non-gas-guzzling van, back when I was an unskilled, New York City-raised 18-year old and didn't even know how to drive. I was just starting to research my limited options when I had a chance conversation with a driver of a diesel Ford Tempo who picked me up hitchiking from a bluegrass party down South. The fuel-efficiency of his car and the positive things he had to say about diesel engine reliability convinced me to go to trade school and learn auto mechanics so that could buy a diesel and maintain it myself. A few years later I learned about vegetable oil diesel fuels, again by chance, through hearing about the Fat of the Land documentary (www.lardcar.com). The idea of a technology that brought together both my pursuit of auto mechanics and my interest in environmental responsibility really set off an 'a-ha!' moment for me, in a way that biofuels seem to do for many people. This sparked a passion for renewable energy technologies in general, and with the coming of the Internet biodiesel discussions in the late 90's, I got hooked into the online open-source biodiesel technology world.

The fact that I had to learn about these important technologies completely through chance conversations rather than learning about them in public school where they should be taught, convinced me to devote considerable time promoting renewable energy by loud example, and creating more 'chance' that others might find my renewable energy experiences useful. I have in recent years become a teacher of biodiesel homebrewing workshops and other renewable energy topics, and am also active in California commercial biodiesel consumers' activism (through the Biodiesel Council of California and the small-scale commercial biodiesel discussion list, "localb100biz"). Some of you may know me from the internet biodiesel discussion forums, where I post as 'girl Mark'

In my homebrew research, I am involved in ways to bring the 'open-source' design philosophy to homebrew biodiesel, including a group-written Biodiesel Collaborative Tutorial at www.localb100.com, and I designed what has since become an 'open-source' biodiesel processor system called the Appleseed Processor (www.veggieavenger.com/media). I also have a self-published book on homebrewing, the biodiesel Homebrew Guide, available through www.localb100.com/book.html.

Maria Alovert (girl Mark)

C F Ls

Compact Fluorescent Lamps

If you're looking to make as much light as a 100 watt incandescant lamp, but only want to use 26 watts of electricity doing it, CFLs are the device for you. These 120 VAC lamps will make a noticeable difference in your utility bill if you change out all the incandescant bulbs in your home. If you're already off-grid, you've probably discovered CFLs already. If not, give 'em a try. They cost more initially, but considering that they last 10 time longer than incandescant lamps, they're worth it. I changed to CFLs in my little 700 sq ft house and noticed an immediate reduction in my grid bill. I'm a believer, and I think you will be too. ldb

Off-Grid Journal

by Steve Spence, Director
www.Green-Trust.org

15 Degree's above zero, and we are being told to look for 6" of snow tonight. The Groundhog saw his shadow, forecasted more winter. so we ate him. Ok, so we didn't eat him, but we are tempted to eat the the raccoon who has taken up residence in our garage, and has been helping himself to the VeggieGen fuel containers.

I'm planning a major upgrade for our rainwater recovery system, including all new rain gutters and a new collection tank. Last years experiment with a 55 gallon slow sand filter was a success, so I'm doubling capacity this year.

Our Amish neighbors have promised to come over with a team of horses, and plow in a few inches of aged horse manure for the garden. I'm thinking of what veggies to start in the greenhouse in a few weeks, and wishing I had more maples on the property for syrup making. I miss doing that.

I've got 7 face cord of wood out front to stack in woodshed, which has had snow on it since the day I finished piling it. Guess it's going to be a while longer before it gets indoors. Yesterday we broke the glass on the new woodstove. Next time I will make sure the wood fits before slamming the door. Picking up a new door tomorrow. My flu medication prevents me from thinking too clearly, and from caring too much that I can't think. I need a vacation. My father-in-law went to Florida for a few weeks, we should have joined him.

It's time to give a few specifics about what we have done to reduce our electrical needs. All our lighting is either compact fluorescent, or an occasional long tube fluorescent. All phantom loads, like TV, Stereo, Microwave, and any other device that's on when it's off, is on switched outlet strips. Our stove is non-electric propane (pilot lights), our water heater is propane (we are planning a solar preheater for this spring), and our dryer is propane heated, but electrically tumbled. We had a propane fridge, but it was too small, and developed a bad combustion issue, so we replaced it with a electric which will run off our inverter and battery pack when the generator isn't running. We have a front loader washer that's very energy and water efficient as well. The only devices we have that will not run from our 2500 watt inverter is the washer, the dryer, and the well pump, a 1/2 hp Gould jet pump.

We have 90 watts of PV with 675 ah of battery storage for night time use, and a 12.5kw vegetable oil powered diesel generator which is our primary power. Details on this system, with planned upgrades, will be provided in a series starting next month.

The toughest lessons we have had to learn is that electricity doesn't come from an outlet, heat doesn't come from a thermostat, and self sufficiency means you don't call someone when things break.

Onward and upwards .....

ESSN Classified Ads

FOR SALE -- Wincharger 1222H 12V 200W Wind Generator. In excellent condition, but currently disassembled. Includes spare bearings and brushes. Prop is in good condition. $1000. info@rebelwolf.com

FOR SALE -- 12.5 KW Biodiesel generators. Conbines the 2-71 Detroit Diesel engine with an extremely heavy duty Delco or Emerson brushless alternator. This is the generator Steve Spence chose for his own BIODIESEL system. Rebuilt units starting at $4395. Non-rebuilt units starting at $1995. www.affordablepower.com 1-888-454-1193 X3

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Circulation Info

It sure has been peaceful this month since we didn't have to fight the hosting wars. Given the benefit of a month of uninterrupted logging, the stats page on the website control panel at Rebel Wolf Online tells me that, as of 0305 EST this morning (28 Feb), 7918 folks have downloaded their own copy of the February issue of Energy Self Sufficiency Newsletter. We thank you for your support and your interest in ESSN and in living lightly on Mother Earth. ldb