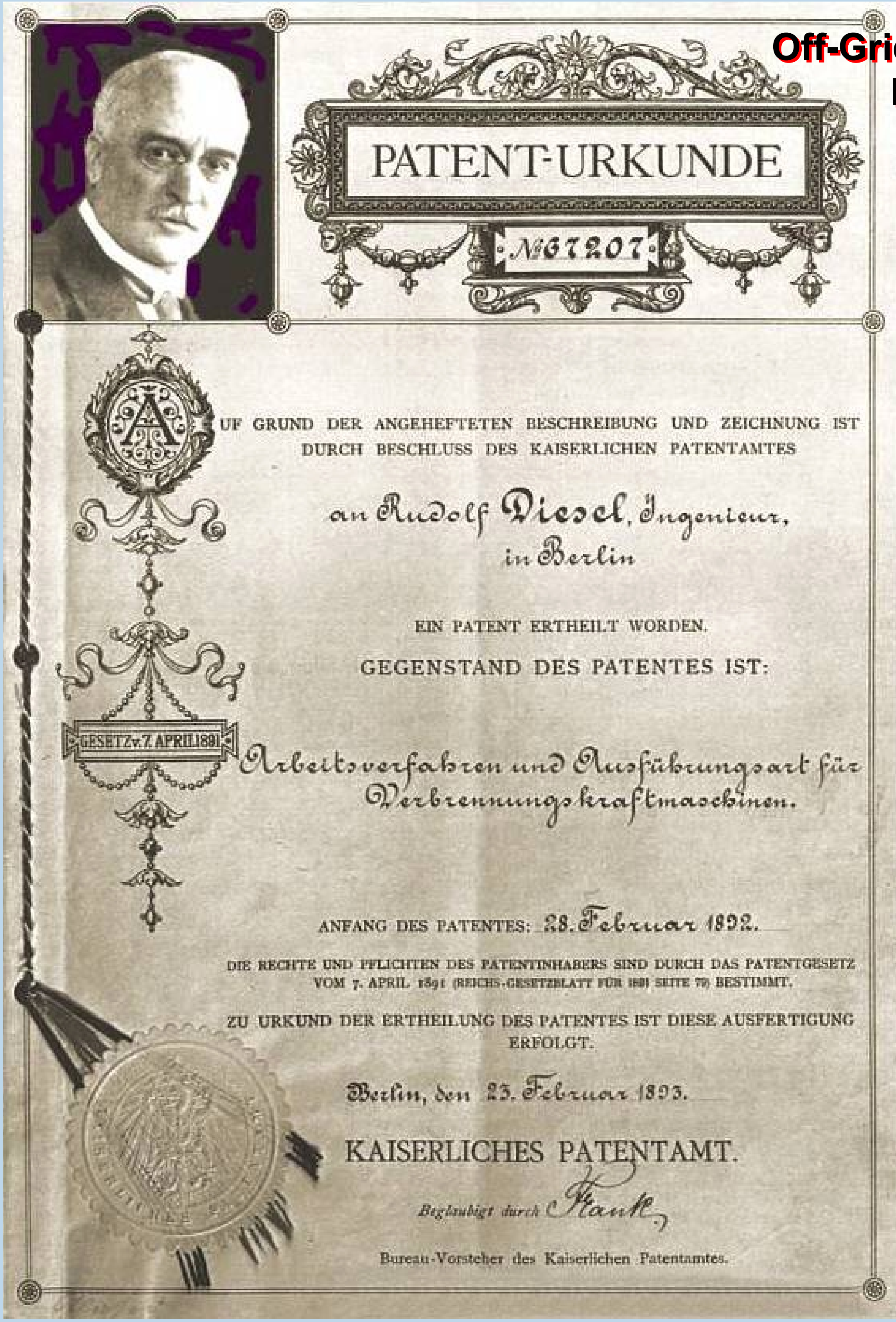
ESSN

April 2006

Off-Grid Living
Biofuels
Hydro
Solar
Wind



PATENT-URKUNDE

№ 67207

AUF GRUND DER ANGEHEFTETEN BESCHREIBUNG UND ZEICHNUNG IST DURCH BESCHLUSS DES KAISERLICHEN PATENTAMTES

an Rudolf Diesel, Ingenieur, in Berlin

EIN PATENT ERTHEILT WORDEN.

GEGENSTAND DES PATENTES IST:

GESETZ v. 7. APRIL 1891

Arbeitsverfahren und Ausführungsart für Verbrennungskraftmaschinen.

ANFANG DES PATENTES: 28. Februar 1892.

DIE RECHTE UND PFLICHTEN DES PATENTINHABERS SIND DURCH DAS PATENTGESETZ VOM 7. APRIL 1891 (REICHS-GESETZBLATT FÜR 1891 SEITE 79) BESTIMMT.

ZU URKUND DER ERTHEILUNG DES PATENTES IST DIESE AUSFERTIGUNG ERFOLGT.

Berlin, den 23. Februar 1893.

KAISERLICHES PATENTAMT.

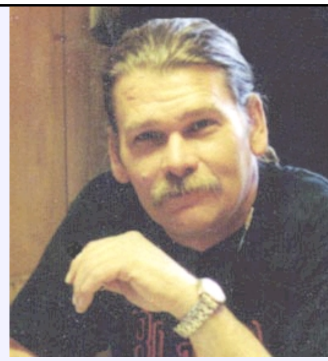
Beglaubigt durch

Bureau-Vorsteher des Kaiserlichen Patentamtes.

Energy Self Sufficiency Newsletter

A Rebel Wolf Energy Systems Publication

TABLE OF CONTENTS



Rebel Wolf Energy Systems

From The Editor's Laptop

by Larry D. Barr, Editor

TALKING TO THE WORLD ON SOLAR POWER

by Larry D. Barr, K5WLF

The morning of 25 March dawned cloudlessly. I know, I was up before the sun (a noteworthy event for me since I'm basically nocturnal and not given to early rising) putting the finishing touches on a couple of "GO" bags that were to accompany me to our first Science Extravaganza at Tarleton State University in Stephenville, Texas. We were offering free planetarium shows all day, "Magic Shows" performed by our student chemistry club, the Tarleton Chemical Society and, the magnum opus of the event, a solar powered amateur radio station.

There's been quite a bit of attention focussed on amateur (ham) radio in America recently, due to the communications services that hams have provided during and after disasters such as Hurricanes Katrina and Rita, and the aftermath of various wildfires that have ravaged parts of the country. In late December 2005, a grassfire overran the small town of Cross Plains, Texas about 80 miles from where I live, resulting in the destruction of approximately one-third of the homes and one fatality. Among the casualties within the infrastructure of the town was the only cell phone tower and the majority of the landline system. There was only one landline phone operational in the entire town and the call went out for amateur radio operators to handle emergency and welfare communications to relief effort headquarters in Brownwood and Abilene. I was one of many operators who answered that call, and while we were fortunate to have grid power at the shelter location, it certainly impressed on me the need for alternative energy sources for our radios and equipment.

So, with a twinge of regret for my former plans, I decided to repurpose my 2 Uni-Solar US 64 PV panels to function as a transportable energy source for my ham gear in the event of emergency. This means that I'll have to wait a while (read: save up more money) before I'll have any PV permanently mounted here at the house. I designed a really neat adjustable mount to secure the panels in the bed of my pickup, but didn't have time to build it, so I relied on what we call in Texas, "Southern Field Expedient Engineering". It ain't purty, but it works. The panels were already mounted on a roof mount from Backwoods Solar, so I put a piece of lumber across the back of the bed and set the mount in with the panels facing rearward and the legs of the mount firmly against the front of the bed. A couple of ratchet straps secured the assembly to the pickup and all was well.

I wired the panels in parallel for 128 watts output and terminated the #12 AWG cable with a pair of Anderson PowerPole connectors from PowerWerx. I also wired short cables with PowerPoles for the input and output connections to the Xantrex C12 PV controller. Wiring equipped with PowerPoles was already on the PowerSonic PS-121000 sealed AGM batteries since they're in daily use here at the house. Everything was ready to go on this end.

After a couple of mid-week trips to the four story roof of the Tarleton Science building (not my favorite place), Gene (K5IIY) and I had the antennas rigged and we were ready to go on the air. We'd set up a 20 meter dipole and a 2 meter

ESSN

Energy Self Sufficiency Newsletter is published quarterly online at www.rebelwolf.com. The publication is free and unlimited printing and distribution is encouraged for the benefit of the renewable energy community.

essn@rebelwolf.com

Circulation Info The First Year

Monthly circulation of ESSN in its first year of circulation steadily rose to over 23,500, firmly establishing it as one of the most popular and informative global sources of practical information about off-grid living and energy self-sufficiency. With your continued interest and support, our aim for 2006 is to build on this successful start by offering articles on an even wider range of subjects. So please do not hesitate to contact us if you would like to contribute your experiences to ESSN. ldb ground plane and left the feedlines on the roof for rapid deployment the morning of the event.

Bill (WA5PB) and his son Drew came by the house about 0730 Saturday to help me get the panels in the pickup and the rest of the gear loaded. Soon we were on the road. I got a couple of odd looks from fellow motorists as I drove up the wheelchair ramp and casually proceeded down the sidewalk and parked on the lawn in front of the Science building. One more trip to the roof to toss the feedlines over the side and we were ready to get the gear set up.

Bill set up his Elecraft K2 for 20 meter work while I was connecting the power system. It all plugged together as planned and soon the West Mountain Radio RigRunner was “hot” and distributing our solar generated electricity to Bill’s radios and to my Yaesu FT-2800M that I’d be using for local 2 meter communications. We were on the air!

Using a digital communications mode called PSK31 that allows him to type his comments into a laptop and prints the responses on the screen, Bill’s first contact was with a fellow ham in Detroit, Michigan and before the day was out, he’d ‘talked’ to hams in Venezuela, France, Hawaii and New York, among other places. Working area repeaters on 2 meter FM, I and several other hams who dropped by enjoyed conversations within a 125 mile radius of our location.

So, how did the PV powered ham experiment work out? Magnificently! I’d put the Medusa Research Digital Power Analyzer inline between the controller and the batteries to keep track of how much power we were putting into the batteries. For most of the day, we were running about 14.2 volts (perfect for AGMs and what I’d set the controller for) at between 4.5 and 5.2 amps. Both the voltage and current had dropped a bit by the time we ‘struck the set’ about 1600. We started with slightly less than a full charge on the batteries (due to a problem with my power supply at the house that the vendor refuses to address), but within an hour of PV operation we had a full charge and never got ahead of the solar panels. We finished the day with the batteries fully charged. Almost seemed a shame to bring them home and put them back on the grid. Needless to say, a new power supply is on my wish list.

I managed to escape the last trip to the roof to take the antennas down. Gene (K5IIY) and Robert (KE5HIX) volunteered for that duty. Special thanks to Bill, Gene and Robert for all the hard work on the project. Also to Jim (W5BWY) and Steve (N5KIU) for stopping by and participating. And to Matthew (NA5K), Ray (N5SR), Griff (N5AG), Cliff (KC5KWX) and all the rest of the hams who called us and had “solar powered QSOs”.

The day was a lot of fun and a great success and we proved two things beyond doubt. One, PV power is certainly a viable energy source for emergency amateur communications and, two, PV power is definitely portable and easily used for any purpose that requires power away from the grid. PV, it’s not just for your roof anymore.

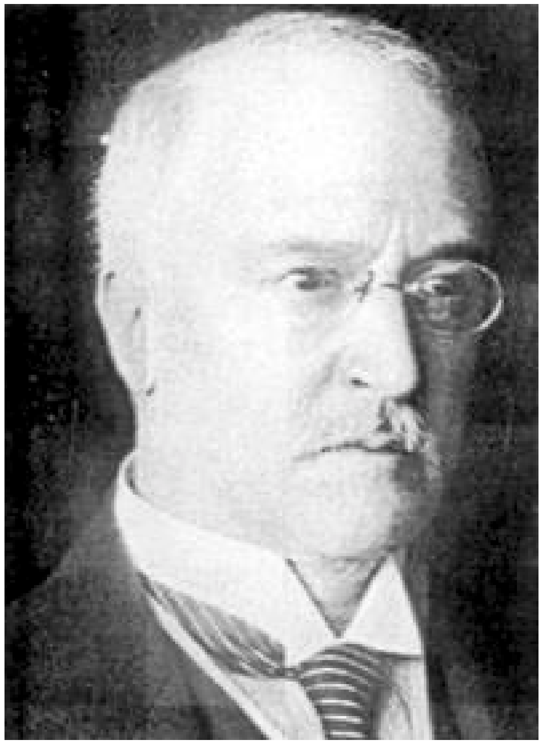
Peace,
ldb

Bill Allen (WA5PB) (l), and Larry D. Barr (K5WLF) at the controls of the Solar Powered Ham Station. In the pickup are the Uni-Solar US 64 amorphous PV panels, Xantrex C12 controller and the PowerSonic PS-121000 100 Ah AGM batteries. The building in the background is the Tarleton State University Science building. The planetarium (Larry’s ‘real’ job) is under the dome.
Photos by Robert Taylor (KE5HIX)

COVER STORY

RUDOLF DIESEL

March 18, 1858 – September 30, 1913



This month, we celebrate the life of Rudolf Diesel, inventor of the Diesel Engine.
We start with a brief overview of his life and achievements (gleaned from Wikipedia, the "free encyclopedia that anyone can edit"), then continue with a very well researched article by **Reece Foxen** that details the history of the diesel engine, its benefits, and the impact it is now having on our lives with the introduction of biodiesel fuels. Finally, **Steve Spence** brings us up to date with the use of used fryer oil in the making of biodiesel.

Early life

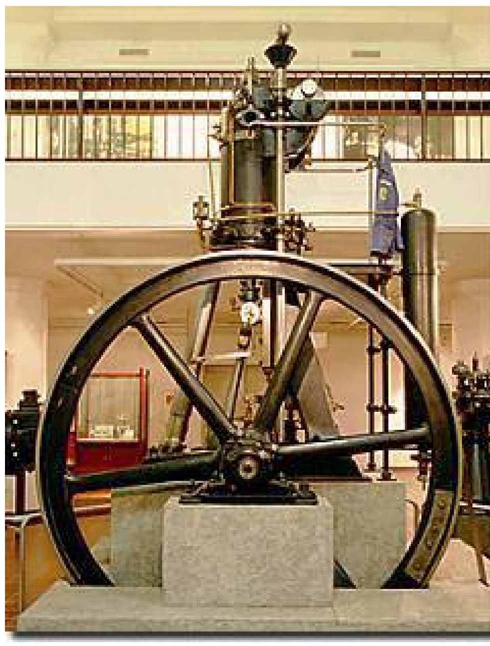
Although Diesel was born in Paris, his parents were German. His father was a leather craftsman, and his mother a governess and language tutor. Rudolf was a good student in primary school and was admitted at the age of 12 to the Ecole Primaire Superieure, then regarded as the best in Paris. On the outbreak of the Franco-Prussian War, however, he and his parents were considered enemy aliens, and were deported to neutral asylum in London. A cousin helped him to return to his father's home town, Augsburg, where he entered the Royal County Trade School. From there he won a scholarship to the Technische Hochschule of Munich, where he was an outstanding student. He became a protegé of Carl von Linde, the pioneer of refrigeration. He was a devout Lutheran.

After graduation, he was employed for two years as a machinist and designer in Winterthur, Switzerland. After this, he returned to Paris, where he was employed as a refrigeration engineer at Linde Refrigeration Enterprises. In Paris he became a connoisseur of the fine arts and an internationalist. He married in 1883, and had three children. He set up his first shop-laboratory in 1885 in Paris, and began full-time work on his engine. This continued when he moved to Berlin, working again for Linde Enterprises. In 1892 he was granted a German patent for the engine, and found some support for its continued development, this time in Augsburg.

Continued on next page

THE MAN AND HIS INVENTION

Rudolf Diesel developed the idea of an engine that relied on a high compression of the fuel to ignite it, eliminating the spark plug used in the Nikolaus Otto internal combustion engine. He received a patent for the device on February 23, 1892 and a major milestone was achieved when he was able to run a single piston engine for one minute on February 17, 1894. The engine was fueled by powdered coal injected with compressed air. This machine stood 10 feet (3 m) tall, and achieved a compression of 80 atmospheres (8100 kPa). He built an improved prototype in early 1897 while working at the Maschinenfabrik Augsburg (from 1906 on the MAN) plant at Augsburg. Diesel's engine had some similarities with an engine invented by Herbert Akroyd Stuart in 1890. Diesel was embroiled for some years in various patent disputes and arguments over priority, but in the end he prevailed, and his invention came to be called the diesel engine. He continued its development over the next three years, began production (the first commercial engine was at a brewery in the United States), and secured licenses from firms in several countries. He became a millionaire.



Diesel was something of an unstable character, having several nervous breakdowns, and was somewhat paranoid at times. He defended his priority of invention tenaciously. Diesel toured the United States as a lecturer in 1904, and he self-published a two volume work on his social philosophy. He died under suspicious circumstances during a crossing of the English Channel to Harwich on September 29, 1913, possibly by suicide. A cross in his journal on the date he died was an indicator of suicide. A briefcase containing a very small sum of money and a large amount of bank statements showing debts, was left to his wife, Martha. Another theory revolves around the German Military, which was beginning to use his engines on their submarines – something which Mr. Diesel opposed –and perhaps feared his potentially providing the technology to the British Royal Navy for use in their own submarines. His body was found in the Channel a few days later. As was usual at the time, the seamen only took his belongings (identified later by Diesel's younger son Eugen) and then threw the body back into the sea.

After Diesel's death, the diesel engine underwent much further development, and became a very important replacement for the steam engine in many applications. This engine required a heavier, more robust construction than the gasoline engine, making it unsuitable for certain applications (such as aviation), but allowed the use of cheaper fuels. Diesel was especially interested in using coal dust or vegetable oil as fuel for the engine, but this never materialized in any major way, at least until recent rises in fuel prices and concerns about oil reserves lead to more widespread use of vegetable oil and biodiesel—most Diesel engines will function just as well using either. But the primary source of fuel has been what became known as diesel fuel, an oil byproduct derived from the refining of petroleum. The Diesel engine became widespread in many other applications, such as stationary engines, submarines, ships, and much later, locomotives.

Recently, Diesel engines have been designed, certified and flown that have overcome the weight penalty in light aircraft. These engines are designed to run on either diesel fuel or more commonly Jet fuel.

A HISTORY OF THE DIESEL ENGINE

by Reece Foxen
Author of this article
and Web Designer for Yokayo Biofuels

The development of the diesel engine and biofuels run concurrent in their history, weaving a story of technological advancement and political and economic struggle. The story of the diesel engine is the more technological aspect of this history, but it becomes easy to see how the political and economic aspects of biofuels impacted its evolution.

Rudolf Diesel (1858-1913) developed a theory that revolutionized the engines of his day. He envisioned an engine in which air is compressed to such a degree that there is an extreme rise in temperature. When fuel is injected into the piston chamber with this air, the fuel is ignited by the high temperature of the air, exploding it, forcing the piston down. Diesel designed his engine in response to the heavy resource consumption and inefficiency of the steam engine, which only produced 12% efficiency.

On February 27, 1892, Diesel filed for a patent at the Imperial Patent Office in Germany. Within a year, he was granted Patent No. 67207 for a “Working Method and Design for Combustion Engines . . .a new efficient, thermal engine.” With contracts from Frederick Krupp and other machine manufacturers, Diesel began experimenting and building working models of his engine. In 1893, the first model ran under its own power with 26% efficiency, remarkably more than double the efficiency of the steam engines of his day. Finally, in February of 1897, he ran the “first diesel engine suitable for practical use, which operated at an unbelievable efficiency of 75%.

Diesel demonstrated his engine at the Exhibition Fair in Paris, France in 1898. This engine stood as an example of Diesel’s vision because it was fueled by peanut oil - the “original” biodiesel. He thought that the utilization of a biomass fuel was the real future of his engine. He hoped that it would provide a way for the smaller industries, farmers, and “commonfolk” a means of competing with the monopolizing industries, which controlled all energy production at that time, as well as serve as an alternative for the inefficient fuel consumption of the steam engine. As a result of Diesel’s vision, compression ignited engines were powered by a biomass fuel, vegetable oil, until the 1920’s and are being powered again, today, by biodiesel.

The early diesel engines were not small enough or light enough for anything but stationary use due to the size of the fuel injection pump. They were produced primarily for industrial and shipping in the early 1900’s. Ships and submarines benefited greatly from the efficiency of this new engine, which was slowly beginning to gain populariity.

Rudolf Diesel literally disappeared in 1913. There is some question of the timing of Diesel’s death. Some think it might have been accidental or even a suicide. However, others considered a possible political motivation. Diesel did not agree with the politics of Germany and was reluctant to see his engine used by their Naval fleet. With his political support directed towards France and Britain, he was on his way to England to arrange for them to use his engine when he inexplicably disappeared over the side of the ship in the English Channel. This clearly opened the way for the German submarine fleet to be powered solely by Rudolf Diesel’s engine. The Wolf Packs, as they were to become known, inflicted heavy damage on Allied shipping during World War I. Still others believed that the French may have been responsible. Their submarines were already powered by diesel engines. They may have been trying to keep the engines out of both the British and German hands. Whether by accident, suicide or at the hand of others, the world had lost a brilliant engineer and biofuel visionary.

Continued on next page

The 1920's brought a new injection pump design, allowing the metering of fuel as it entered the engine without the need of pressurized air and its accompanying tank. The engine was now small enough to be mobile and utilized in vehicles. 1923-1924 saw the first lorries built and shown at the Berlin Motor Fair. In 1936, Mercedes Benz built the first automobile with a diesel engine - Type 260D.

Meanwhile, America was developing a diesel industry. It had always been part of Diesel's vision that America would be a good place to use his engines. Size, need, and the access to biomass for fuel were important and part of the American scene. Adolphus Busch acquired the rights to the American production of the diesel engine. Busch-Zulger Brothers Diesel Engine Company built the first diesel engine in America in 1898. But, not much was done with development and design of the engine here until after World War I.

Clessie L Cummins, a mechanic-inventor who had been set up in business in 1919 by the investment banker William Glanton Irwin, purchased manufacturing rights to the diesel engine from the Dutch licensor Hvid. He immediately began working on the problems, which had been inherent in the engine since its inception - those of size, weight, and instability created by the fuel system. Cummins soon developed a single disk system that measured the fuel injected. Like the other early engines, Cummins' products were stationary engines and his main market was the marine industry.

It was also during the 1920's that diesel engine manufacturers created a major challenge for the biofuel industry. Diesel engines were altered to utilize the lower viscosity of the fossil fuel residue rather than a biomass based fuel. The petroleum industries were growing and establishing themselves during this period. Their business tactics and the wealth that many of these "oil tycoons" already possessed greatly influenced the development of all engines and machinery. The alteration was first step in the elimination of the production structure for biomass fuels and its competition as well as the first step in forcing the concept the of biomass as a potential fuel base into obscurity, erasing the possibilities from the public awareness.

1929 and the Stock Market crash brought the threat of bankruptcy to Cummins. In an innovative move, he installed a diesel engine in a limousine and took his backer, Irwin, for a ride, assuring further investment. Cummins continued to experiment with the diesel vehicles, setting a speed record in a Duesenberg at Daytona, driving a truck with a Cummins diesel engine coast to coast on $11.22, and establishing an endurance record of 13,535 miles at Indianapolis Speedway in 1931. Cummins' diesel engines were established and trucks as well as other fleets began using them. Over the years, Cummins has continued to improve the efficiency of the diesel engine, providing technological innovations. Their engines have set a high standard for the industry, exceeding the requirements of the Clean Air Act of 1970.

As noted before, Mercedes Benz began building diesel driven automobiles in the mid-1930's. These were dependable, enduring automobiles that lasted well into the second half of the century. Early American Ford automobiles were not diesel driven, but they were powered by the biomass fuel, ethanol. Henry Ford shared a similar vision with Rudolf Diesel. He believed plant-based fuel to be the basis of the transportation industry. In a partnership with Standard Oil, he helped further the biofuel industry in the mid-west, encouraging development of production plants and distribution stations. But, as with biodiesel, this vision was obliterated by the petroleum industry and ethanol disappeared from the scene. Europe remained the leader in the development and production of diesel and biomass fuel engines for automobiles.

The 1970's arrived and the American people, who were firmly dependent on foreign oil, yet, unaware of the depth of their dependence, were suddenly faced with a crisis. In 1973, OPEC, the Middle Eastern organization controlling the majority of the world's oil and our main supplier, reduced the supply of oil and raised the price, sending the United States into a crisis. This crisis was recreated in 1978. Long lines at the gas pumps occurred. People panicked as they realized our whole infrastructure depended on the consistent supply of oil - foreign oil - to our economy. Conservation and alternatives became important.

The American public looked to diesel fuel which was more efficient and economical and they began buying diesel-powered automobiles. These automobiles accounted for 85% of Peugeot's sales, 70% of Mercedes Benz's sales, 58% of Isuzu's sales, 50% Volkswagen's sales, plus a good portion of Audi's, Volvo's and Datsun's sales during the 1970's. For the first time, an American manufacturer began producing an automobile with a diesel engine. General Motors made and sold diesel automobiles in the late 1970's, accounting for 60% of all diesel sales in the United States. This surge of diesel sales in American ended in the 1980's. The price of oil had been re-stabilized and the immediate need for conservation receded in the American consciousness. Along with this, the automobiles produced by General Motors were basically converted gasoline engines. The higher compression of the diesel combustion caused blocks to crack and crankshafts to wear out prematurely. GM ended production of its diesel automobiles in 1985.

Continued on next page

As we entered the 21st Century, only Mercedes Benz and Volkswagen made diesel automobiles for export to the United States. Sales accounted for less than 6% for Mercedes Benz and less than 5% for Volkswagen. A few light trucks utilizing diesel engines were made by American manufacturers, but no automobiles. Diesel engine efficiency and durability kept them the engine of choice for trucks, heavy machinery, and marine engines. The marketing of the petroleum industry and the American desire for immediacy and ease have kept the use of the diesel engine from becoming part of the consciousness of the general population here in America.

Looking to our future, our relationship with the oil industries and our dependency on foreign oil, hopefully, will drive us to explore alternatives with a more open mind. Experiments like the Veggie Van and Journey to Forever demonstrate what is possible if we are willing to change in a positive direction or maybe it is to revert back to the original vision of Rudolf Diesel and his engine.

Benefits

Rudolf Diesel designed his first engine in the 1890's to use the available local fuel sources such as vegetable oil and tallow. These fuels were from sustainable renewable feedstocks, easily accessed by the average person. His intention was to empower, both psychologically and economically, the small industries, farmers, craftsmen, and artisans who were struggling to survive the steam-engines industrial monopolies. This humanitarian vision has been revived with the resurgence of the biofuel industry. Along with this revival of a vision comes the possibility of re-empowering ourselves and our communities.

In our highly complex society, it seems the "bottom line" is always economic or political. The human and environmental becomes incidental in the process. This is often true in a discussion on the benefits of biofuels - human beings and their surroundings become second thoughts to the "more important" issues of the day. We established Yokayo Biofuels with human beings, our community, and the environment as our focus with the usual "bottom line"incidental, and, at the same time, recognizing its necessity.

Because the consciousness in this society, including our own, is founded on an economic philosophy this section proved to be the most difficult to develop. It was hard to maintain the importance of the planet and those that inhabit it in the discussion. The economic and political kept turning out to be the most prominent. Suddenly, the most obvious became apparent - start with the benefits to individuals and move in an ever widening progression to the broader areas of economic and political. Yes, they will be the last discussed, but hopefully, the discussion will be done with a sense of being interconnected with the humanism that has gone before.

Uses of Biodiesel Fuels

Biodiesel fuels can be used in all diesel and compression ignition applications that are in existence today. Its use requires little or no modification to the engines or to the storage and delivery infrastructure. Biodiesel is simple to use. It is non-toxic and biodegradable and can be used neat (pure, 100%), as a blending stock in any percentage, or as an additive. In other words it is an environmentally safe and cost-effective alternative fuel.

Today, one is able to find a wide range of diesel-powered cars elsewhere in the world. Many countries are moving to increased use of biodiesel in an effort to reduce pollution and the enviromental impacts of fossil based diesel fuel. However, here in the United States, we are limited in our choices to a few models made by Mercedes and Volkswagen. Ford and Chrysler make light and medium duty diesel trucks for the private consumer. RV's and some utility vehicles also have biodiesel potential.

Each day fleets of trucks criss-cross our nation, carrying goods to all corners. The engines in these trucks have the capability to use biodiesel, if it is readily available. The supply chain simply needs to exist. Stations with pumps providing biodiesel to these trucks and individual consumers are beginning to appear. In the year 2001, Sparks, Nevada was the first in the nation to designate a biodiesel pump. San Francisco, California and Jefferson City, Missouri soon followed. Yokayo Biofuels in Ukiah, California has a pump slated to open in the late Spring 2003 for drop-in customers. Until biodiesel pumps become more prevelant, trucking fleets and individuals are putting in their own storage tanks to fill their needs. There is no problem with safety, making this is a viable possibility until there is a "pump on every corner" or at least in every city. Storage tanks are one solution for short haul and local usage, but long haul trucks still need the increased infrastructure.

Large fleets such as that of the US Post Office, state fleets (Ohio, Utah, etc.), and private companies (Phoenix Concrete and Thanksgiving Coffee) use biodiesel to run their equipment and vehicles. Many agencies within the US Government utilize biodiesel in tanks, boats, utility vehicles, generators, heavy equipment, and so forth.. The Army and Air Force, the Department of Forestry, the General Services Administration, and the Agricultural Research Services are just a few

Continued on next page

agencies using biodiesel. The National Parks Service uses it in their boats and vehicles in an effort to reduce pollution in our oceans and lakes and protect the environment.

Transit systems in many cities and areas such as San Francisco, California, the St. Louis area, Northern Kentucky, and Breckenridge, Colorado use biodiesel fuel in their buses. School districts have found that the benefits, both environmental and health, make utilizing biodiesel in their buses and other diesel vehicles a wise choice. Deer Valley School District in Arizona was one of the first to move in this direction.
Construction companies benefit tremendously from biodiesel usage since most of their equipment is diesel driven including catapillars, cement trucks, dumptrucks, bulldozers, spreaders, front loaders, cranes, backhoes, graders, and all sizes of generators and diesel trucks.
In agriculture, we find not only a possible source for biodiesel, but a consumer of biodiesel. Tractors, reapers, tillers, pickers, conveyors, generators, pumps, and irrigation systems all use diesel fuel in their work, bringing agriculture full cycle from producer to consumer.

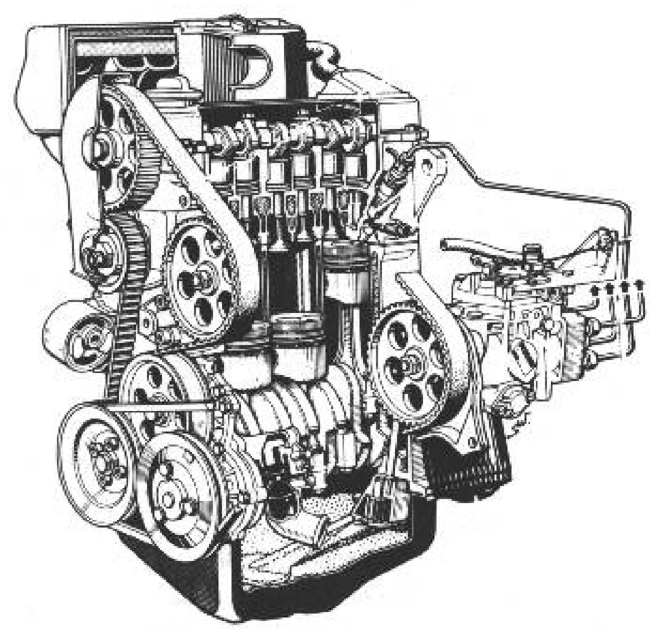
Any diesel driven generator such as those that fire up power plants or oil furnaces are potential users of biodiesel fuel. Mining equipment also falls into this category with their generators and ore cars. Diesel trains add to this list. Sierra Railroad uses biodiesel for running their trains as well as in a unique project of using the locomotives' diesel engines to generate electricity for consumer use.

We cannot forget marine applications. Submarines no longer use biodiesel as they did in the early 1900's, but fishing fleets and other commercial fleets, ferries, recreational yachts, sailboats, and motor boats are all candidates for biodiesel. Some lakes are requiring the use of biodiesel, because it is non-polluting, unlike Diesel #2 and Ventura Harbor (Ventura, California) now has biodiesel available for all boaters. Maui Scuba Tours and the Pacific Whale Foundation (Maui, Hawaii) use biodiesel in their boats. Splash Tours in San Francisco run their amphibious tour fleet on biodiesel.

Biodiesel is an ideal product to use in oil spill clean-ups in the ocean. And, since it is non-toxic and biodegradeable, it can also be a great asset in cleaning the wildlife affected by these spills, although Ivory soap is used most often. Biodiesel is a solvent, removing paint and cleaning out the sludge in tanks that have been used for Diesel #2. Finally, biodiesel is a excellent lubricant for all machines, large and small.The engines of trucks, buses, and larger equipment that use biodiesl have their lives extended due to its lubricity. For smaller machines like sewing machines, biodiesel acts similarly to a 3-in-1 oil.

As noted at the beginning of this section, any application for a diesel engine is a potential consumer of biodiesel. We have just touched the surface of the uses for this alternative fuel. If one looks at the range of companies and agencies utilizing biodiesel at this time one can get a feel for the possibilities and gain a measure of hope for our future.

Reece Foxen



THE FRY GUYS IN THE 21st CENTURY

Steve Spence, Melvin Martin & Luray Martin

explain their process of providing a environmentally friendly, low cost, sustainable fuel for the 21st Century. They collect, filter, and use Used Fryer Oil in a variety of Diesel engines and equipment.

Background

As Reece has described in her article, Rudolf Diesel originally experimented with a variety of "fuels" including coal dust. Around 1900, he demonstrated his engine running on peanut oil in Paris at the exhibition. His stated goal was an engine that could be run by farmers, and fueled by crops. It's our goal to show folks how to get back to the roots of clean burning, sustainable, home produced fuel production, instead of the dirty, finite "solution" we have been fed, that ties us to outside interests that in many cases are volatile.

Collecting Used Fryer Oil

Our story starts with collecton. We travel to area restaurants collecting their used oil. The restaurants we deal with have to pay to have their used oil disposed of, so they are happy to give it to us. Some oil is waiting in the 4.3 gallon jugs they buy it in, the rest is in 55 gallon drums we provide them. Depending on the weather, we either pump it from the drums into drums on our trailer, scoop it out with 5 gallon buckets, or swap drums entirely, leaving an empty one behind. In winter, we usually scoop the heavy grease with a pail until the barrel is light enough to lift onto the trailer. Once it's on the trailer, we take it home, and pump or dump the oil into our wood fired boiler. The pump is currently a 2" jet pump connected to a gas engine, but we are looking for a electric version powered by our veggie powered Suburban. The wood boiler is a 300 gallon stainless tank on a steel firebox.

Growing your own Oil

If you have enough acreage, it's possible to grow and press your own oil for food. You can also have a leftover seedcake useable as animal feed. It might take 15 acres of sunflowers to keep a VW Jetta in enough fuel for 500 miles a week. You can find info on oil presses at Oil Press Info.

With Canola (based on rapeseed), we have observed 42 bushels per acre (organic). At 55 lb per bushel, that's 2310 lb of seed. With 42% available as oil, that's 970 lb of oil. At 8lbs per gallon, that's 121 gallons of oil per acre.

Oil Press

Filtering Used Fryer Oil

Once the boiler is full of used oil, we build a fire under it with scrap and slabwood from the sawmill. This wood is free, and a recycled renewable source. It takes about 6 hours in winter, less in summer to bring the oil to about 250 F. This removes the water from the oil. We then let the oil sit overnight to cool to 130F for filtering. The junk settles to the bottom during this time. We pump the oil from the boiler with a suction strainer, working from the top layers, connected to a 2" jet pump into a 55 gallon drum with a 5 micron sock filter inserted. We can usually filter at about 40 gpm. The filtered oil is drained into 55 gallon drums on the trailer for delivery. We pump from these drums into fuel tanks in the suburbans, jetta, rabbit, and VeggieGen. Excess oil is pumped into old propane tanks for storage.

Using Used Fryer Oil

The trick to using used fryer oil in a diesel engine is to provide a second, heated tank onboard. We also install a heated filter. The engine is started on diesel, and when the cooling system warms up, and heats the veggie oil in the second tank, we switch from diesel to hot veggie. at the end of our run, we switch back to diesel to clean out the system. For our VeggieGen, we use a 55 gallon drum for a veggie tank. We took the rear heater from a school bus, and connected it to the cooling system, and dropped it into the barrel. The fuel pickup is attached to this heater.

We sometimes install manual switching valves for selecting which tank to draw from and return, other applications call for an electric valve.

The filter is designed around the Carquest #524840. This filter is designed for fuel dispensing at 60 gpm. We wrap a piece of sheet steel around it 1" larger in diameter, bend the fingers in and daub liberally with epoxy. Weld on the coolant fittings and circulate hot coolant around the filter. We sell this heated 10 micron filter for $250. A smaller unit for passenger cars is available for $150.

In cold climates we insulate the lines, filter, and tank with foam pipe insulation.
See the photo's in VeggieGen and Filter Build, as well as our 2006 GMC Sierra (Duramax) conversion.
VeggieBenz Article

Making Biodiesel

The other method of using fryer oil in a diesel is to make Biodiesel. Biodiesel is a chemical conversion of the oil, using lye and alcohol, to allow it's use in unmodified diesel's. We supply Biodiesel Processors and more info on making Biodiesel can be found at the Biodiesel Community website. Discussion groups include:

Biodiesel BiodieselBasics BiodieselBiofuels

Heating your Home

Can you heat your home with veggie oil or biodiesel? Yes you can, but it takes some serious modifications to your furnace or boiler. The folks at the following groups talk, test, and develop ways to do just this:
altfuelbabington
altfuelfurnace
wastewatts
homebrewpower

Powering your Home

We live off-grid, so our main source of power is our veggie fueled Detroit Diesel featured in the first photo with Steve Spence decorating it. The Detroit 2-71 is ideal for running wvo due to it's positive displacement gear pump for fuel delivery, head encased fuel lines, and cam driven injector/pumps. This engine will start on 20F slushy oil. The engine is a 68hp, 2 cylinder 2 stroke. It has a 12.5 kw 3phase gen head installed, delivering all the power we need.

Steve Spence

More pics can be found here.
Good references include:

Girl Mark's	Biodiesel Homebrew Guide
LILI's	How to make Biodiesel
Joshua Tickell's	From the Fryer to the Fuel Tank: The Complete Guide to Using Vegetable Oil as an Alternative Fuel
Lyle Estill's	Biodiesel Power : The Passion, the People,and the Politics of the Next Renewable Fuel
Greg Pahl's	Biodiesel: Growing A New Energy Economy
Larry Barr's	ESSN Magazine
Ken Boak's	Lister

IS IT COOL TO BE HOT?

by Suzanne Ubick

I'm still thinking – not that I'm obsessive or anything! – about the generation and distribution of energy within one's home. That tangle of wires and ducts in the basement of my friends' house has really gotten my attention.

Reagan's infamous comment about "shivering in the dark" certainly does not apply to me. I don't like being chilled, and I do not like the dark; I am a depressive, and lack of light is a major trigger for me. San Francisco's famous fogs may soften the edges of the city, but they do nothing for my emotional well-being.

Note from Mike: have a peek at these nifty gadgets!
http://www.solatube.com/res_brightenup.php

Given then that we all like warmth and light, especially in winter, and don't like sitting in sweaty puddles in the summer, wouldn't it be better to consider point-of-usage devices and prevention rather than cure?

In the point-of-use scenario, I was thinking about things like chilly bedrooms. Is it necessary, I wondered, to heat the bedroom when one actually sleeps in the bed? It would use less energy to heat the bed. And there are several ways to do this, ranging from a dog or two (our small Shiba Inu insists on sleeping across the tops of our pillows and it's amazing how warm one is with a dog on one's head) to an electric underblanket. A nice thick sheep fleece under the bottom sheet is pleasant, and in less extreme climates may obviate the need for an electric underblanket. Putting a thick canopy a couple of feet above the bed, and thick curtains around it, will keep cold draughts out and breath-warmed air in. I can't sleep if my feet are cold, so my winter sleeping attire includes thick socks. A low-tech bed warming device is the faithful old hot brick, or hotwater bottle, wrapped snugly in a nice thick towel. Under the feet, or against the back, or pressed to the navel, the bottle keeps one warm all night – and in the morning the water is hot enough for washing one's face and whatever bits need freshening up before dressing for the day.

Speaking of dressing for the day, it isn't much fun to shudder into stiff cold clothes and fight your buttons done with stiff cold fingers. How about dressing in the bathroom, or the closet if that's big enough? A small fan heater will soon get this small space toasty.

Seeing we're still in the bathroom, it doesn't make either sense or cents to have a big central water heater in the basement and run hot-water pipes to the bathroom. It's an interesting exercise to measure the cold water displaced through the hot water faucet before the first warm trickle reaches you. A point-of-demand water heater, either gas or electric, though expensive to buy is economical in use. There's no storage tank required either. I've even seen advertisements for water heaters that are built into the shower head! Myself, I prefer baths to showers, so I'll stick with a small geyser. That's what we call water boilers in my neck of the woods, I guess because a geyser is a jet of hot water. My husband, though, took exception to my remarking that I didn't like the geyser (pronounced geezer) in the garage – he thought I was talking about him…

Continued on next page

I thought my mother-in-law was a little odd in her insistence on washing clothes in hot water and rinsing in warm, and washing dishes under running hot water – and she uses twice as much hot water as the other three inhabitants of this house put together. But then I found, both on Littlehouses.com and Simpleliving.net, that this is the norm. Still disbelieving, I asked my friends and acquaintances; yes, they do the same. When asked why, the commonest reply was "sanitation." When I asked "sanitation against what?" there were long silences. For most of us, our clothes and dishes are very lightly soiled, and almost never exposed to contamination by large groups of strangers. Essentially then one is sanitizing one's clothes and dishes against one's own germs. And it takes live steam to kill all pathogens anyway.

I wash my dishes in warm water because I wash by hand, and have skinny chicken-feet hands that get really cold really quickly; they get decidedly painful. Clothes, though, are done in the washing machine, and they don't feel the cold at all.

Another thing about washing clothes in hot water is that biological substances are "set" by heat – just like boiling an egg. Stains have to be soaked out in cold water.

But there are times when hot water is useful for laundry – I like to boil my week's usage of dishtowels after soaking them in cold water and detergent. I like a fresh dishtowel and kitchen cloth every day – dishes do not get dried chez moi; they air dry in the draining rack next to my sink. The dishtowel is for hands. While I was on Sipan, I washed the cloths in warm water because I could hang them in that lovely hot sunshine for hours and hours. Here, I have to line dry indoors and scalding the cloths helps to freshen them up.

So how about buying a washing machine that heats its own water? This is the standard for washing machines in Europe. It's true that a wash cycle run with very hot water takes a long time – two to three hours – but that helps a lot in deciding whether or not the load really needs a hot wash!

I had one of these babies my last couple of years in South Africa. And did it come in useful when the gas-fired geyser ceased to work! I'd start my Indesit, set it to HOT, and when the water was heated I'd set the machine to DRAIN and the water pumped into the bathtub! While one person bathed, the machine was heating the water for the next tubful.

Some educated dishwashing machines heat their own water too. Not only is this a frugal idea, energy wise, but it prevents sudden scalds and freezes for persons taking showers, and doesn't deplete the hot water tank if you still have one.

Then there's heating the person rather than the room. Good thermal undies, covered with fleecy layers of clothes, and especially a woolly hat and woolly slippers or undershoes, go a long way to making a cold room bearable.

Heating myself once nearly led to a conflagration of self! My ex-husband had for once taken the children with him for the morning, and I was freezing in our caravan. Ooooff. There was a fire going outside, under the donkey boiler – so I got the bright idea of setting up the zinc washtub on its side, facing the fire, and sitting in the tub. Well, it worked too well. After a few minutes I noticed a strange smell, and then saw wisps of smoke curling from my shoes…the rubber soles were beginning to melt…I went to bed instead, with all the bedding I could find heaped under and over me.

I was very impressed with the clever idea I read about in a recent AARP newsletter. A woman wrote in that she puts a chicken brooder bulb in the light socket above her chair – and that provides all the heat she needs while in that room.


No Suzanne – it should be a light, not a chicken! Mike

Mostly, I'm still speculating on ways to reduce the need for energy, whether point-of-use or omni-directional.

I'm a little embarrassed to admit this; it only occurred to me last week to close the inside shutters on our windows. They're not good shutters, just standard economy slatted wood folding shutters, but do they make a difference! Thermodynamic law states that heat moves toward cold, but I don't agree; it certainly feels as if icy waves sweep from the windows into the room. Now I'm going to have to make thermal liners for the shutters.

From cold to heat; shutters and drapes are also excellent for reducing heat gain. But to be most efficient, they have to be outside the windows. Light passing through glass is slowed down and converted to heat. It is easier, and cheaper, to stop the light from hitting the windows in the first place. Window awnings may be sufficient for east-facing windows. For south-facing windows in late summer, with the sun lower in the sky, one might need to consider shadecloth drapes outside the windows, or slatted shutters – with the windows open. West-facing windows need the heaviest protection. Solid shutters or canvas "tents" or vine-covered arbours would all work well.

Continued on next page

My experience during my Sipan summer was that the house stayed coolest with the windows open day and night – as long as those western windows were shaded throughout the long afternoons and evenings.

In South Africa's Karoo, houses were built with verandas running all the way around; this kept the sun off the windows during the day. People would leave the windows open all night to cool off the house; come dawn the paterfamilias would patter around, closing the windows to hold in the cool air so the scorching Berg winds wouldn't heat the house up again.

Another device I've seen used extensively in South Africa and in Europe is roof vents. These might take the form of metal pipes inserted along the ridgeline of the roof, with cowls on top to keep out the rain. These are usually painted black and heat rapidly in the sun; the resultant stack effect draws air through the house. Another version is the gable vent. In a house with its long sides running east to west, there is a cute little shuttered doorway in each of the eastern and western gables. The big heat differential between the east and west sides of the house draws cooler air through the roof space, and draws hot air from the ceiling level of the rooms. Much less common, because of the roof pitch, are vents on the north and south sides of the house, but I have seen these too. They look like mini-dormer windows, again with slatted shutters. I've seen photographs of pioneer houses in Australia built with roof vents – especially when roofed with corrugated iron.

Shanty towns are common in South Africa, and an innovative idea rapidly adopted outside Pretoria some years ago was the plastering of the corrugated-iron and flattened-paraffin-tin huts with papercrete. Several coats of oil paint made the exterior waterproof. Reports indicated that the comfort level of these homes was vastly improved both in summer and winter – as well as their appearance.

Poring over my Permaculture Designer's Manual, I found many good ideas for passive house-conditioning. There's the unglazed earthen pot, filled with water and placed in a draught – this technology appears in many cultures. In South Africa's Karoo, a biome very dear to my heart, early settlers cooled their homes with blankets soaked in water, hung over the open windows. Same principle, different application. There are pits and tunnels that draw cool, moist air into the house. There are punkah wallahs, if you can bribe your offspring to pull on the ropes that will swish the huge palm-leaf fans back and forth. Without bribable offspring, how about a 12V DC fan or two, powered by solar panels?

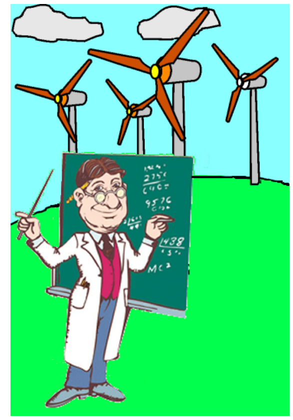
During my first marriage, our caravan rested in breathless dry heat in the Karoo, freezing conditions with snow and ice in Lesotho, suffocating humidity along the eastern coast, and finger-and-toe stiffening dry cold around Pretoria. We had no electricity, barring the 12V lights run off the truck battery. The stove and fridge ran off bottled LP gas. There was no insulation worth speaking of in this home-on-wheels. I was forced to be creative, and I read everything I could find. After reading about the wet blankets on Karoo houses, I draped wet sarongs over the caravan windows; the cooling was almost instantaneous. When nights were hot, I draped dampened sarongs over my children so they could sleep. In the cold, there was nothing to do but bundle up. We got a kerosene space heater one year, but active toddlers are a very bad mix with such things.

Suzanne Ubick

Karoo housing – town and country

THE WIND BAG

by Dan Fink



The highlight of this issue's Wind Bag column is a contribution from Victor Creazzi, owner of Aerofire Windpower in Lafayette, Colorado. He sells, installs and services everything from small 1kW Bergeys and Whispers for remote off-grid homes, up to 65kW Vestas turbines that can power a small business, subdivision, or remote community center. He works on even larger wind turbines, too. Victor is extremely knowledgeable about the practical aspects of wind turbines for generating real power.

Victor's article discusses the restoration of an old Jacobs wind turbine from start to finish. Since many readers may not be familiar with these beautiful, elegant machines, I'm going to interject some wind turbine history before moving on to his article.

Some of the best small wind turbine designs ever came from the USA in the 1920s and 1930s. Joseph and Marcellus Jacobs manufactured wind turbines in the 1 to 3 kW range, and these are still known as the 'Cadillacs' of wind turbines. Enthusiasts still get an electric thrill of excitement when they explore the base of an old, rusted tower install from 80 years ago and find the body of an old "Jake" buried at the base. Depending on the condition, these vintage gems can be restored—parts and new turbines are still available.

When the Jacobs company was started in the 1920s, most farms and ranches in the rural US did not have any electricity at all. Gasoline powered 'light plants' were common, charging 32V battery banks to run lights for the farmhouse, small irrigation pumps for stock barns, and crystal radio sets. The generators had large flywheels, ran at very slow RPM, and sipped fuel instead of gulping it, compared to modern generators. Fairbanks Morse, Onan, and John Deere were common brands. Their slow 'putt putt putt putt' was a common sound on most farms in the US during that era. Edison batteries (Nickel-Iron) were the usual way to store the electricity. If you are interested in old light plants, be sure to check out Otherpower.com's fossil fuel generators links for access to enthusiast's websites worldwide. The remote, off-grid workshop where we build our wind turbine kits and parts gets its backup power from a 'new antique' light plant—an exact copy of a Lister diesel engine from the 1930s, but built brand-new in India. It's extremely slow-running, fuel-efficient, and quiet.

The Jacobs brothers built their wind turbines to fill this niche, and free farmers from the maintenance hassles and fuel cost of using gasoline generators as their only source of electricity. Many turbines were made to produce 32VDC, the standard of the day. Most Jacobs machines incorporated a flyball governor that changed the pitch of the blades so the machine could survive high winds. These turbines went into decline during the US great depression in the 1930s, when a government works program called the REA (Rural Electrification Administration) went into action, subsidizing the extension of power lines to remote areas all over the US in an attempt to stimulate the depressed farm economy. When REA power hit the farm, the old Jake was no longer needed, and many of them fell into disrepair and eventually fell off the tower to be buried in the earth.

The Jacobs design became prominent again during the 1970s oil crisis, and the company's intellectual property was purchased. Changes were made to include direct grid tie applications, too. Now, the WTIC company still holds all the patents, molds, dies and machinery for the Jacobs design, and you can still purchase one new! And though the REA program electrified 98% of the farms in the US by the 1970s, the problem of infrastructure (power line extension) still exists; it can cost $50,000 per mile to extend power lines now, and there are no longer any government subsidies for doing it. I live in that remote 2% that still has no grid power, too.

The old, vintage Jacobs design still competes well with all the modern wind turbines that are available for purchase – in fact, many "Jake" owners would say it far surpasses the modern designs in performance and reliability.

DAN FINK

Continued on next page

NEW LIFE FOR OLD JAKE

by Victor Creazzi

My client Joe E. located and purchased an out of commission Jacobs 10 kW wind turbine and 80' tower in Nebraska. Joe arranged for a local crane and flatbed tractor-trailer and hired me to disassemble the tower, rebuild the turbine, and erect it in Colorado.

Although this turbine was designed and manufactured by Marcellus Jacobs, it is considerably different from the old DC Jacobs that made him famous. Where the original Jacobs had a direct drive DC generator and up to 3 kw, the modern 10 through 20 kw Jake turbines have a 99º or 102º gearbox that drives a brushless three-phase alternator located vertically in the top section of the tower (called the stub tower). The fact that the alternator is static in the tower alleviates the need for slip rings. The gearbox also allowed the use of near off-the-shelf alternators from Fidelity, Onan, and Winco. A brake on the output shaft of the gearbox is used to shut down the turbine for maintenance as opposed to manually furling the tail on the older version. One thing that is common to both the early model DC units and the more modern AC units is the blade-activated governor.

When I got to the site, I climbed the tower to drain the gearbox oil before the crane arrived (if the gearbox is laid down with the oil in it, the grease is washed out of the lower pinion bearing). With a bucket in place, I removed the drain plug to find no oil – a bad sign. The Nebraska owner had said that the brake did not work and had wrapped chains around the blade roots to keep the turbine from spinning.

When Joe and I got the turbine on the ground and unwrapped the chains, we could see that the front bearing on the input shaft was extremely loose. At this point I pronounced the gearbox "junk." We also found the governor to be frozen. The faces of the wooden blades were in very bad shape as

the predominant wind was from the south, putting the front sides of the blades into the sun and wind for 20+ years. Fortunately, the leading edges and the backsides of the blades were in very good condition due to the fact that the rotor wasn't free-wheeling all of those years, though the turbine was free to yaw and follow the wind.

After getting the machine and tower back to Colorado, I brought the blades, governor, and gearbox to my shop in Lafayette. I disassembled the gearbox to verify that the gears were trash; they were. The teeth were nearly gone from both gears. With help from Robert Preus at Abundant Renewable Energy (ARE), a used gearbox was located and shipped to us.

Continued on next page

It turned out that the brake was fine after freeing it up from 20 years of non-use. The reason the former owner thought it didn't work was because the gears were stripped in the gearbox, allowing the rotor to free-wheel.

I replaced the blade shafts and fabricated one of the blade brackets, which had been destroyed during the disassembly of the governor. After the blade bushings were replaced, we had a working governor: a very elegant device in my opinion. I filled, sanded, and painted the blades and applied new leading edge tape before balancing them.

Meanwhile, we had gotten a permit to install the turbine at Joe's house in Weld County. However, Weld County zoning only allowed us to a height of 70' without a variance. I determined that we could put in the j-bolt anchors for the bottom and second sections of tower in the same concrete piers (see photo). For expediency, we decided to erect the turbine on the 60' of tower, get everything working and inspected, and then, get the height variance and install the bottom section bringing the tower height back to its 80' configuration.

During all of this we were waiting for the approval of Xcel Energy (the local utility) to connect to their system and net meter the energy. It took three months to get a "NO!" from them. The reason for non-acceptance was the inverter that was supplied with the system. Even though there are hundreds of these inverters on the grid, the utility would not accept it without UL 1741 compliance, which did not exist at the time the inverter was manufactured.

This left us in a lurch. There were a number of possible options, but they all required building a custom control unit. One option that I considered was adapting the turbine for 48 volt battery charging and doing the grid tie with a Xantrex SW inverter (Outback's grid tie was still in the coming-soon stage.) However, Joe did not want batteries. Another option was possibly using the Grid Tech 10 (TM) that Xantrex had developed for Bergey Windpower and is used on Bergey's Excel-S grid-tie turbine. This would require Xantrex to create new software to load the turbine properly. With a demand of one unit, I expected this to be nearly impossible.

About this time I was hearing about SMA modifying their Sunny Boy inverter's algorithm to produce a Windy Boy. The Windy Boy was available in Europe but not yet listed for use in the good old USA. A possible problem was that the Windy Boy's operating voltage required 150-400 volts DC and the Jacobs normally operated at 40-180 volts AC.

The off-the-shelf design of the Fidelity alternator used on the unit I was working on meant that it came with a standard 12 lead reconnectable output. I climbed the tower, reconnected the output for high voltage, and connected a rigged power source to the exciter. (The exciter is a small inside-out alternator on the shaft of the main alternator. The output of the exciter is rectified on the spinning shaft and fed to the rotating field. This is how the whole system is made brushless. It also means that the field current is a product of the exciter current and the RPM.) While watching a frequency meter to determine the speed of the turbine, I verified that it was possible to develop 150 volts at cut in speed.

Now, all I needed was a control unit! Where, oh where to find one? First, I needed something that would vary the exciter current to keep the output voltage of the alternator linear with respect to the speed of the turbine. Second, I needed a way to limit the peak voltage to a safe level. The rectification and filtering of the alternator output would also be accomplished in this magic box. The control unit that I eventually designed and built (referred to affectionately, in house, as a "Jakey Boy") turned out to be more challenging than I had originally anticipated, but it has worked flawlessly since its birth - well, actually since its adolescence. Most importantly, it has made the marriage of the 10 kw Jacobs to modern UL-listed inverters possible (and happy even!).

Prior to building the control unit, decisions on the number and size of inverters had to be made. At the time, the Windy Boys that were available were either 1800 watts or 2500 watts. The 2500-watt model had a voltage range of 200-600 volts. 200 volts at cut in speed may be do-able, but I was concerned about being able to reach this high of a voltage at cut in wind speeds. This, and the fact that Robert at ARE already had experience with the 1800-watt model on his grid-tied AWP turbines, settled the size issue.

Continued on next page

The next thing to be decided was the number of inverters to use. The 10 kw Jacobs develops 10 kw at 25 mph at sea level. At an altitude of more than 5000 feet, we could expect 15% less at that wind speed. The Windy Boys vary their output based on the voltage supplied to them; the slope and start voltage can be programmed by the distributor. I reasoned that the best way to implement the Windy Boys would be sequentially (e.g. the first inverter reaches full power before the second cuts in, etc.). In order to load the turbine properly, the load slope of each succeeding inverter must be steeper than the one preceding so that the combined slopes approximate a cubic relationship. (The power in the wind varies with the cube of the speed.)

Optimistically assuming an average of 10 mph at the site and a Reyleigh distribution, I determined that if we used four 1800 watt inverters programmed sequentially, the first inverter would do 71% of the work, the second 18%, the third 8%, and the fourth 3%. Based on this, I suggested three inverters or possibly only two. We decided on three. To date, the first has produced 69%, the second 25%, and the third 6%. If I were doing this project today, I would use the larger 6000 watt unit that is now available to save money and complexity.

Since its installation, the turbine has had more than a year of trouble-free operation. During its annual check up, I discovered looseness in the front bearing. After removing the blades and governor, I found that the $1.38 lock washer that keeps the adjusting nut from turning had broken and allowed the bearing to loosen. Fortunately, this was caught during the annual inspection. If it had gone unnoticed, the situation could have been much more serious. As it was, it hadn't even damaged the seal. (See how important those scheduled inspections are?) While the blades were off, we decided it was a perfect time to raise the tower to 80'. We are looking forward to the improved energy output from the taller tower.

Victor Creazzi
Aerofire Windpower
303.665.3991 - aerofirewp@yahoo.com - PO BOX 394 Lafayette, CO 80026

by Dave Gibson
Yankee Lighting Co.

One would think that Amish people would shy away from LED lighting because LEDs need electricity to operate, however the Amish are not the techno-phobes that they're made out to be. In fact, the Amish are far ahead of the Detroit auto makers when it comes to the use of LEDs on their vehicles. Amish buggies have had LED tail lights since 1999 and the first buggy to have LED headlights hit the road in August, 2001. Meanwhile, auto makers around the world still have no production vehicle with LED headlights.

The Amish are attracted to LED lighting, mostly because of their energy efficiency. Their carriages are powered by deep-cycle batteries that usually have to be removed from the carriage and connected to a charging system. With conventional carriage lighting, recharging had to take place after only 4 to 6 hours of use. If an Amish buggy has both LED head and tail lights, the recharge is often stretched out as far as 40 to 80 hours. The down side now is that many of them are destroying their buggy batteries. Live and learn, I guess. At least there are less and less Amish buggies driving down dark roads without lights.

LEDs for 12 Volt Area Lighting

A great race is on between LED manufacturers to create Power LEDs suitable for area lighting. Are LEDs good for area lighting? In my own humble opinion, yes, for some things. For most applications, compact fluorescent lighting (CFL) is the way to go due to the overall efficiency of lumens per watt. For those of you who don't know, lumens are like gallons. Most white LEDs spit out roughly 18 - 25 lumens, with some much higher around 50 or so lumens per watt. When it comes to the most lumens per watt, CFLs at 60 to 80 are king … for the time being, that is. For LEDs, 100 lumens per watt is possible … on paper. Engineers are fast working on LED solutions that have this kind of output.

One of the obstacles to achieving this is referred to as lumen maintenance. In other words, how long the LED itself will give a usable light output. Keeping the LED cool and proper LED packaging are two key elements. Two of the better designed Power LEDs are manufactured by Lumileds and Cree. Both manufacturers have good designs for heat dissipation, however additional heat sinking is usually required. Lumileds uses an optical grade epoxy for their lens packages, while Cree uses glass and both packages hold up well for a long time. There are a lot of LED manufacturers that use an improper epoxy package that reacts with the LED phosphorus coating. The epoxy tends to get a foggy appearance which

Continued on next page

cuts down on the amount of light output. As with everything, its buyer beware. The ol' saying, "you get what you pay for" applies to LEDs. If you're in the market for white LEDs, do your homework and spend the extra money for the better devices.

Another issue with white LEDs is color temperature, meaning the shade of white that is emitted by the LED. Even the best Power LEDs run from a pitiful greenish white, to very blue. LED manufacturers have been developing special phosphorus coatings with some success, to produce shades of warm white targeted at indoor lighting applications. Again, in my own humble opinion, there is a lot of room for improvement and CFLs are a much better way to go for indoor lighting … for the time being. I keep saying "for the time being" because I believe that eventually, LED manufacturers will end up finding ways to make LED lighting practical and affordable for the average consumer. The odd shades of white emitted by most current LEDs is tough to get used to for indoor areas. Believe me when I say that I've heard more than my share of complaints from the Amish about the funny color of their buggy headlights. For them, it's a trade off between the strange color of the light and having to handle and charge a 50 pound battery twice a week.

White Power LED technology is very much in its infancy and much better days are coming. Being an LED lamp manufacturer brings me a lot of inside information and I'm hearing some very exciting scuttlebutt from the manufacturers; most of which I am bound by contract to not disclose until it's made public knowledge. Hang in there! Until then, use lots of CFLs. By the time they burn out, white Power LEDs may come of age.

There are some elite products available using the currently available white Power LEDs, but I personally view them as play things and conversation pieces for the fincancially well off. There are however, many practical uses for these early white Power LEDs, if one wants to spend the money, that is and even if you're not Amish.

- **Flashlights** – This one is obvious. There are hundreds of companies making LED flashlights.
- **Outdoor Flood Lighting** – I tried CFLs for lighting my driveway, but in cold weather they just didn't come to full brightness fast enough for me. I've built some very effective flood lamps using white Power LEDs and used them to light my driveway. I got full brightness immediately and they did not seem to be affected by the cold Pennsylvania winter weather. I noticed that my eyes adjusted very well when stepping out of a dark area and into an area illuminated by LED floods. I recently moved and I'm going to build some new floods for this driveway. I'll be sure to give some photos to ESSN when I do build them.
- **Accent lighting** – Landscape lighting, wall washers and dozens of other novel applications. Lots of products available.

Experimentation - This is my favorite application of all! Build something on your own ... anything! Even if no one else likes what you've invented, you'll have a great feeling of satisfaction in completing whatever the project is. The Internet has loads of information on how to work with LEDs. Just build it, I say! Be sure to brag about it too!

My goal was to cover additional issues of efficiencies in LED lighting however, in the interest in meeting ESSN's deadline for this release, I'll have to cut this article a little short. Next time we'll get a little more technical and maybe cover some subscriber questions and input.

Dave Gibson
Owner of Yankee Lighting Company
1787 Route 208
Emlenton, PA 16373
(814) 797-0271
djg@yankeelights.com

Head and tail lights on an Amish carriage

HOW TOUGH IS YOUR CLIMATE FOR SOLAR HEATING?

by Laren Corie

It's spring again, and some of our thoughts are turning to building, instead of love. Whether we are remodeling, or building new, energy should be a major priority in our plans. The first, and usually most costly mistake that is made by owner builders, is to assume that planning is easy, and can be done by inexperienced people starting only a few months before breaking ground. I won't be saying any more about that, except that competent design and the acquisition of bargain materials takes longer than the actual construction. Good design is particularly where large amounts of money can be saved or lost.

A good understanding of some basics of energy management in the home is therefore extremely useful for anyone intending to build a home or addition. One of those basics is insulation. I'll be getting into more detail on that subject in future articles but, for the moment, it's only important to understand that a home gains energy not only from the electricity that powers it, or from the fireplace or heating furnace, but also from the people and pets living in it! Above all, it should never be forgotten that a home gains energy from the sunlight shining in and on it and, because of all these energy gains from people, pets, and that great big furnace in the sky, doubling the insulation can more than cut the heating bill in half during winter months. In contrast, it won't cut the cooling bill by anywhere near as much during the summer!

When I say "heating bill", I'm referring all the additional heat that must be deliberately provided by all but the "organic heat generators" living in the house. Depending on the heating needs of the house (insulation, climate, solar design, etc) there may be no need for a furnace. A little heat stolen from the water heater may suffice as the only "backup" for the alternative energy systems.

In virtually all habitable climes, it's practical to build in such a way that no central furnace is needed. "Practical" means "cost effective", and cost effective means that initial investment in a little thought and materials will give a better return on your investment than a conventionally heated home with its higher heating bills. Energy efficiency offers benefits not only for the environment, but also enhances both personal and national security factors.

So, it's highly advantageous to insulate very well, and to Solar orient your home or addition. However, every climate is different, and knowing "how, and how much" becomes the big question when you pass from theory onto real world implementation. That brings me to the subject of this article, which is the heating needs of a house compared to the available sunlight for locations throughout the contiguous 48 States in the US. If you live somewhere else, then this comparison should still be of interest as it highlights similarities and differences in climates where we would not automatically expect to see them. Quite often, the answer is not intuitive!

Before you look over the numbers, I'd like to stress that they only apply to the coldest months in North America, in the heart of winter (December and January). This is just a small sample, and it should be borne in mind that heating will also be needed during the milder months either side of this period. However, they highlight factors like the need for a backup, and the relative difficulty of achieving 100% solar heating in each particular location. Please also note that these figures alone don't reflect the total saving that can be obtained in these climates. As a matter of fact, the toughest solar heating climates are often the ones where there is the greatest advan-

Continued on next page

tage, because they have the longest heating seasons. For example, Northern Michigan, where I live, is the toughest region for achieving 100% solar heating. This is due to the combination of cold weather and cloud cover produced by the “lake effect” from lakes Michigan and Superior. However, it’s still a very effective region for solar space heating as we enjoy relatively sunny autumn and spring seasons. Even in summer, there’s a need for heat. What Virginia has for a winter Michigan gets for both its autumn and spring. So, any costs for solar heating will be returned twice as fast in Michigan. For a more detailed discussion on this topic, and a comparison, please see my previous article in the March 2005 issue of ESSN (It’s Too cold and Cloudy for Solar...Not!).

That brings use to the numbers. They’ve been based on data from the National Renewable Energy Laboratory, which got them from official records from weather stations around the nation. It’s based on averages from the years 1961 through 1990, so they don’t include much of the climate change that we have recently experienced. For instance, in areas with Great Lakes lake effect, there may now be much more cloud cover during January because the lakes no longer begin to freeze over until late February, if at all. There have also been changes in temperature due to heat island effects from expanding cities. In addition, the air is much cleaner in many locations now. This is particularly important in cities set in mountain valleys, such as Kalispell, Montana, which is rated as the toughest solar climate. They had a terrible problem with air quality from auto exhaust and wood stoves, but mounted a very effective municipal campaign and no longer have the problem. (For more info see the Montana Official State Website).

Except for those isolated mountain valley locations, which seem to have corrected their conditions, the Great Lakes “effect” and the similar conditions in Quillayute and Olympia Washington, seems to be the dominant factor in producing a challenging solar space heating climate. In other areas, cold brings on crystal clear skies with northern latitudes providing more direct sunlight on south-facing walls. Of the 21 most difficult solar space heating climates (with the exception of Kalispell and Missoula which seem to have cleared up their polution, and International Fall which is just plain cold), all the rest are because of lake effect cloud cover, with all but Quillayute and Olympia Washington being from the Great Lakes.

One other important factor that needs to be taken into consideration is snow cover. With the sun low in the southern sky, a freshly snow covered field can reflect as much as 90% of the light that hits it. This can create an enhancment of the Solar energy hitting vertical windows of 40% or even more in some unusual instances such as a north facing slope to the south, which replaces deep blue sky with a bright snow reflector to redirect solar radiation. Similarly, a south facing slope to the north will reflect solar radiation back to the south – if that sounds like gobbledegook, just think of those sun reflectors that sunbathers use!

Have fun looking up and comparing various locations. They will fairly well relate the relative amount of glass that will be required for the same percentage of solar heating in the various locations. Notice that locations like Muskegon MI will need twice as much collector area as Boston, even though they are at similar latitudes, and even have fairly similar winter temperatures. Traverse City, Michigan, gets only a third as much Dec-Jan sunshine per heating degree day as Denver Colorado. This means that a house around Traverse must not only have three times as much collector area, but that in the real world, it must collect and retain enough heat in one day to make up for many cloudy days.

This means that the simple passive strategies of just letting the sun shine in on massive floors and walls to raise the living space temperature enough to keep it warm until tomorrows sunshine will not work well for a high percentage of Solar space heating. For these cold cloudy areas, a super-insulated house with moderate south facing glass is needed, supplemented by a big sunspace over the whole south wall, and separate heat storage – either in the attic, under the floor, or both. Such a house will also work well in more sunny areas, due to the control and isolation of the collection from the primary living spaces.

May your lives be filled with sunshine,

Laren Corie
Natural Solar Building Design Since 1975

TURN TO THE NEXT PAGE TO SEE A COMPARISON CHART

Continued on next page

The numbers represent the total sunshine (BTU/ft²) for every HDD (Heating Degree Day) per average day of each month. I have placed them in an order relative to the most severe month for each location. The overall message of this article, is to not expect a standard, simple, direct gain, New Mexico house to preform to the same level in other climates.

Location	Jan	Dec
Key West FL	972	2552
Miami FL	465	990
W Palm Beach FL	315	528
San Diego CA	180	182
Tampa Fl.	170	236
Los Angeles CA	156	141
Long Beach CA	140	141
Daytona Beach FL	136	183
Phoenix AZ	134	138
Brownsville TX	128	175
Tucson AZ	120	124
Dagget CA	101	101
Santa Maria CA	100	103
Corpus Christi TX	90.8	121
Jacksonville FL	88.4	110
Las Vegas NV	82.0	81.9
Victoria TX	79.2	100
Tallahassee FL	76.3	93.2
Austin TX	72.4	87.3
San Antonio TX	75.9	91.0
El Paso TX	72.5	77.0
New Orleans LA	71.0	95.0
Port Arthur TX	70.3	92.5
Savannah GA	70.3	85.1
Lake Charles LA	68.4	88.5
Mobile AB	66.8	84.4
Midland/Odessa TX	66.2	73.6
Charleston SC	66.8	84.0
San Angelo TX	65.8	74.2
Houston TX	65.6	82.9
San Francisco CA	64.5	67.3
Baton Rouge LA	63.9	83.8
Waco TX	61.5	73.4
Abilene TX	63.1	71.8
Lufkin TX	60.3	73.2
Dallas/Fort Worth TX	58.3	69.0
Columbus GA	58.2	69.0
Wilmington NC	57.5	69.9
Montgomery AB	57.4	70.6
Macon GA	57.0	68.8
Lubbock TX	56.5	59.5
Tucumcari NM	55.2	56.7
Cape Hatteras NC	54.8	69.6
Shreveport LA	54.2	63.7
Augusta GA	54.0	65.1
Prescott AZ	54.5	55.3
Bakersfield CA	55.8	54.2
Albuquerque NM	53.2	54.2
Columbia SC	53.1	64.1
Wichita Falls TX	52.8	58.6
Meridian MS	51.3	62.0
Jackson MS	50.6	61.8
Athens GA	50.5	56.3
Amarillo TX	50.2	52.0
Greenville SC	47.8	52.5
Arcata CA	47.7	46.8
Atlanta GA	46.7	54.1
Oklahoma City OK	46.3	49.3
Huntsville AB	46.0	53.5
Birmingham, AB	45.9	53.5
Charlotte NC	44.3	50.0
Memphis TN	43.7	48.4
Littlerock AR	43.6	47.8
Flagstaff AZ	43.5	44.1
Raleigh/Durham NC	43.3	49.1
Fort Smith AR	43.1	46.1
Tonopah NV	43.9	43.0
Pueblo CO	42.6	43.7
Fresno CA	45.6	42.3
Norfolk VA	41.7	49.1
Sacramento CA	42.9	41.6
Tulsa OK	40.8	43.7
Greenboro NC	40.3	45.3

Location	Jan	Dec
Asheville NC	40.3	43.9
Cedar City UT	40.3	40.7
Dodge City KS	40.1	41.2
Colorado Springs CO	40.1	40.1
North Bend OR	40.8	39.1
Boulder/Denver CO	38.8	39.1
RenO NV	39.3	38.4
Lynchburg VA	38.3	41.7
Goodland KS	38.2	37.7
Richmond VA	37.2	41.4
Chattanooga TN	36.9	40.3
Roanoke VA	36.4	39.3
Nashville TN	35.8	38.8
Wichita KS	35.8	36.9
Ely NV	35.2	34.5
Alamosa CO	34.2	35.4
Knoxville TN	33.8	40.4
Springfield MO	33.6	34.3
Cheyenne WY	33.5	33.9
Grand Junction CO	33.2	36.4
Winnemucca NV	32.0	31.8
Baltimore MD	31.6	33.6
Bristol TN	31.0	34.7
Scottsbluff NE	30.9	31.2
Topeka KS	31.1	30.7
Atlantic Cty NJ	30.8	33.2
Sterling VA	30.2	32.1
St Louis MO	30.2	30.2
Columbia MO	30.2	29.8
Kansas City MO	29.8	29.8
Willminton DE	29.7	31.9
North Platte NE	29.5	29.7
Grand Island NE	29.5	29.3
Elko NV	29.3	29.3
New York Cty NY	29.2	30.3
Philadelphia PA	28.9	30.8
Newark NJ	28.8	29.7
Landers WY	29.0	28.7
Boston MA	28.6	28.7
Casper WY	28.9	28.2
Eagle CO	27.9	27.9
Evansville IN	27.8	29.2
Providence RI	27.5	28.0
Bridgeport CT	27.4	27.7
Rock Springs WY	27.6	27.3
Louisville KY	27.3	29.2
Rapid City SD	26.9	27.0
Harrisburg PA	26.4	26.4
Lexington KY	26.3	27.8
Charleston WV	25.5	27.1
Huntington WV	25.5	26.7
Springfield IL	26.0	25.5
Salt Lake Cty UT	25.3	24.9
Norfolk NE	25.7	24.6
Omaha NE	26.3	25.9
Portland ME	24.9	24.4
Billings MT	24.2	24.8
Allentown PA	24.2	24.1
Sheridan WY	24.0	24.1
Covington KY	23.8	23.8
Hartford CT	24.3	23.1
Astoria OR	24.7	23.0
Des Moines IA	26.1	22.9
Worchester MA	23.9	22.9
Boise ID	22.8	22.9
Indianapolis IN	23.3	22.6
Pierre SD	22.7	22.2
Sioux City IA	23.6	21.8
Peoria IL	22.8	21.8
Concord NH	22.9	21.6
Elkins WV	21.4	21.5
Dayton OH	22.3	21.3
Moline IL	22.2	21.2

Location	Jan	Dec
Burns OR	22.1	21.1
Miles City MT	21.2	20.7
Great Falls MT	21.0	20.7
Redmond/Bend OR	27.1	25.6
Medford OR	25.3	20.2
Sioux Falls SD	21.3	20.1
Pocatello ID	20.2	20.2
Williamsport PA	20.9	19.9
Rockford IL	21.4	19.8
Lewiston MT	20.3	19.8
Huron SD	20.3	19.8
Cut Bank MT	20.0	19.7
Salem OR	23.2	19.6
Columbus OH	20.2	19.6
Chicago IL	20.7	19.3
Eugene OR	23.6	19.2
Waterloo IA	20.4	19.2
Portland OR	21.7	18.9
Wilkes-Barre PA	20.4	18.9
Pendleton OR	20.0	18.9
Yakima WA	21.0	18.8
Madison WI	20.6	18.7
Milwaukee WI	20.6	18.7
Mason City IA	20.4	18.6
Helena MT	19.2	18.5
Albany NY	20.3	18.2
Bismark ND	19.2	18.2
La Crosse WI	20.0	18.1
Binghamton NY	18.0	15.8
Fort Wayne IN	19.5	17.9
Green Bay WI	19.5	17.9
Pittsburgh PA	19.0	17.9
Massena, NY	17.7	15.8
Minneapolis/St Paul MN	19.9	17.4
Toledo OH	19.3	17.3
Mansfield OH	18.3	17.3
Minot ND	18.2	17.3
Fargo ND	17.4	17.3
Seattle WA	19.3	17.1
Akron/Canton OH	17.9	16.9
Glasgow MT	17.5	16.9
Rochester MN	18.7	16.7
Detroit MI	18.3	16.6
Eau Claire WI	18.4	16.4
South bend IN	18.0	16.1
St Cloud MN	18.3	15.9
Syracuse NY	17.8	15.8
Massena NY	17.7	15.8
Spokane WA	17.9	15.6
Rochester NY	17.2	15.6
Caribou ME	17.6	15.5
Cleveland OH	16.7	15.5
Flint MI	17.2	15.3
Buffalo NY	16.4	15.3
Lansing MI	17.0	15.0
Burlinton VT	17.5	15.0
Duluth MN	16.7	14.9
Youngstown OH	15.9	14.9
Grand Rapids MI	16.4	14.8
Bradford PA	16.6	14.7
Quillayute WA	19.5	14.5
Olympia WA	16.7	14.5
Alpena MI	17.1	14.3
Erie PA	15.9	14.3
Sault Saint Marie MI	15.5	13.9
Missoula MT	15.1	13.5
Muskegon MI	14.1	13.4
International Falls MN	14.4	13.0
Houghton MI	14.3	12.5
Traverse Cty MI	13.7	12.4
Kalispell MT	13.5	11.6

Disclaimer:

These numbers are only intended to offer a very rough comparison. They have been double checked, but errors may still exist.
Also, due to the circuitous path by which I arrived at these particular values, there will be variations, especially due to rounding off.

ESSN Classified Ads

!!! <u>DIY AND SAVE</u> !!!

Emergency generators with storage battery and inverter, Photovoltaic (PV) kits, Solar powered hydrogen fuel cells, Biodiesel processor kits, and diesels running on used fryer oil (WVO).
Give us a call for the latest in DIY self sufficiency. 845-832-7211 or sspence@green-trust.org

WOODSTOCK, CT: GEOTHERMAL HOME FOR SALE
($479,900)

Geothermal heating and air conditioning - fuel independent. Custom designed with Australian Cypress flooring, gas log FP, central vacuum, custom tile floor in kitchen, bathrooms with marble vanities, jacuzzi tub.

Click here for full full details

$188 per month for utilities. 7.8 Acres.
Contact PATRICIA MALEK (agent): 860-779-7460
Email: 1stchoicerealty@sbcglobal.net

Better Times Almanac of Useful Information, Wisdom, Recipes, Conservation.

Free download at http://www.bettertimesinfo.org/2004index.htm, or for a free printed copy send a large (9"x11") SASE, with $1.06 in US postage to Better Times, 1524 NW 21, OKC, OK 73106.

FOR SALE -- 12.5 KW Biodiesel generators. Combines 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

Ghost Writing

Hey folks, do you have experiences you'd like to share with other ESSN readers. Many of you have energy self sufficiency related experiences or information that you'd like to share with ESSN readers. If you're comfortable writing, please submit your article to essn@rebelwolf.com.

On the other hand, if you'd rather not do your own writing, this forum is the place where you can get together with folks who'd like to do some writing with you: http://www.green-trust.org/forum/viewtopic.php?p=1050 . So, if you're one of those folks who wants to work on a collaborative article, just post here that you're available and check out the posts from the folks who are looking for you.

I'm hoping to see a lot of fresh content for ESSN come from this forum. We'll be waiting for your posts. All of you!

Peace,
ldb

THE AMPHORA SOCIETY

Mike Nixon, together with his close friend and colleague Mike McCaw, founded The Amphora Society several years ago. One of the first things they did was to write a book about distillation that is now widely acknowledged as the clearest book that has ever been written on the subject – so much so that it is now used as a text by many schools and colleges around the world.

The Compleat Distiller

Why is it so popular for colleges and amateur distillers everywhere? The simple reason is that it covers the whole subject from beginning to end in a clear, easily understood way. It sweeps away all the myths and old wives' tales that have previously made distillation such an mysterious, complicated and arcane subject to understand.

A full description of this book, complete with details of the contents of each chapter, may be found at
The Amphora Society

Contact **Green Trust Sustainability & Renewable Energy** Website

MAKE YOUR OWN HOME HEATING OIL AND DIESEL FUEL FOR LESS THAN $1.00 / GALLON

Our Biodiesel processor kits are only $375
(includes S&H Continental US)
You just supply a electric water heater of 30 - 80 gallon capacity, and consumables, consisting of new or used vegetable oil, methanol and lye.
Assembly instructions are included
email us to order

WASTE VEGETABLE OIL CONVERSION KIT

Did you know you can run your diesel on used fryer oil? Yes, that stuff the restaurants throw away is actually fuel! Make your own fuel for your vehicle, generator, or heating oil furnace. WVO Conversions start at $850 for a passenger car and can cost as much as $2k for a large truck. Processor kits start at $375.
Drop us an email for details

BUILD YOUR OWN EMERGENCY GENERATOR

Want your own Emergency Generator? We have put together a kit which includes a 3hp vertical shaft gasoline engine, 94 amp alternator, mounting bracket, 4" pulley, V-belt, battery cables, 115ah deep cycle battery with case, 700 watt inverter, and mounting base with casters. You get both 12vdc and 120vac outputs. Will power a small TV and a 15 watt fluorescent light for 15 hours between engine charging. Can be used for pumping water from rain barrels and many other purposes. Additional battery capacity, 12vdc appliances, and custom configuration available.
2 year manufacturer's warranty on engine, 1 year on rest of system
$750 (includes S&H, continental USA)
Drop us an email for details

SOLAR PANEL KIT

Construct your own Solar Panels

Includes interconnection Components
Yes, you can build your own Solar Panels. From small cell phone chargers, to running a laptop, radio, and TV. We provide:
- New, Undamaged Solar Cells
- Interconnection Material
- Soldering Iron
- Liquid Flux for easy soldering
- Instructions, Soldering and wiring diagrams, tips for inexpensive housings

Power up your RV or off-grid home
18v @ 0.7A (12 watt panel) $99
17.6V @ 1.2A (21 watt expansion pack, cells only) $149
(S&H included, Continental US)
email us for details

AWARD WINNING FUEL CELL KIT

Offered by Green Trust: this leading educational kit to learn all about solar energy and hydrogen fuel cells

Build your own hydrogen fuel cell with this kit

- Assemble and Experiment with a Unique Reversible Fuel Cell Kit. This fuel cell kit provides an excellent introduction to one of the most significant technologies of the 21st Century. Build a model car that actually runs on water!
- The electricity required is generated by a large solar cell. Water is then electrolysed to form hydrogen and oxygen, which is stored as the fuel. When required these gases are fed into the fuel cell to provide electrical motive power.
- **The kit contains**:

Complete reversible fuel cell (hydrocycle system), wire, motor, chassis, axle, gas collector, 4 wheels, solar panel with support, syringe, tube, digital multimeter, test tube, protective goggles, labels, bag of small parts for fuel cell, bag of small electronic parts, and a comprehensive lab manual with 30 experiments and demonstrations.
$150 (Free S&H Continental USA)
Email us to order, or for shipping to other areas

ESSN Classified Ads

ESSN
Classified Ads
are an effective
and economical way
to get your message out to the
Renewable Energy Community

ads@rebelwolf.com

Ad Rates

Watch For New Low Ad Rates in the Next Issue!!!

Full Page
7½″ W X 9¾″ H
$150/month
$750/6 months
$1250/year

Half Page
$4^{7}/_{8}$″ H X 7½″ W or $3^{5}/_{8}$″ W X 9¾″ H
$90/month
$450/6 months
$750/year

Quarter Page
$3^{5}/_{8}$″ W X $4^{7}/_{8}$″ H
$60/month
$300/6 months
$500/year

Eighth Page
$3^{5}/_{8}$″W X $2^{7}/_{16}$″ H or $1^{13}/_{16}$″ W X $4^{7}/_{8}$″ H
$45/month
$225/6 months
$375/year

Classifieds
$0.25/word/month
20 word minimum

Want to barter for ads?
What have you got to offer?

ESSN

Circulation Info The First Year

Monthly circulation of ESSN in its first year of circulation steadily rose to over 23,500, firmly establishing it as one of the most popular and informative global sources of practical information about off-grid living and energy self-sufficiency. With your continued interest and support, our aim for 2006 is to build on this successful start by offering articles on an even wider range of subjects. So please do not hesitate to contact us if you would like to contribute your experiences to ESSN. ldb