USER GUIDE

PEDAL POWER GENERATOR

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Pedal Power Generator

Basic Idea:

While jumping or running our legs are generating 50-200 Watts of power. If this is converted to electricity and stored in a battery can't we use it in the night for lighting purposes?

For example:

A 11 Watt CFL bulb can light up a room. Radio, taperecorder, loud speaker use about 1-5 Watts. An LED light consumes less than 1 Watt. Thus a human being is capable of generating his/her own lighting needs!

How AID approached the problem:

We initiated a collaboration with the Industrial Design Centre, IIT-Mumbai through a student-project. By Jan 2000 the prototype of the Pedal Power generator generating 40 watts was ready. This excited activists such as Michael Mazgaonkar who connected us with Ronnie Sabawalla of Rashron Auto Ltd. To take a laboratory model to the point of mass production we need people experienced in manufacturing. By June 2000, Ronnie Bhai made a new prototype that could generate 70 Watts. This was installed in Domkhedi village, which is in the tribal belt of Maharshtra where there is no electricity grid. When the Satyagraha against submergene due to SSP dam was launched in July 2000, thousands of people came from these regions and when they saw this Bijli Bike they pedalled! Medha Patkar commented that this was the first CFL in the valley, more than 50 years after independence! The brightly lit

Satyagraha hut in the dark background of the hills was quite a sight even from a distance. The feed-back of the village people on posture and pedalling speed helped make an improved batch of 7 new pedal powered generators.

By 2001-2002 the design has been perfected and the Pedal Power Generator is available from Rashron Ltd through mail order. It costs about Rs 7500. AID is subsidizing about 50 % of the costs for schools and NGOs working in villages without electricity. More than 30 generators to groups in several states including Jharkhand, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat have been dispatched. To order contact aid@vsnl.com

Simultaneously we are collaborating with BSFC in Mozda village to set up a workshop so that alternate energy through pedal and wind can be pursued there. This will help create livelihoods in the rural areas while providing electricity.

Why are Village People So Interested? The Economics...

We conducted an energy survey in Nimgavhan village, that neighbours Domkhedi. On an average a tribal household consumes 3-5 litres kerosene a month for the kerosene lanterns or oil wicks. At Rs 9 per litre this is about Rs 35 a month. In addition batteries for torchlights cost another Rs 30 or so a month. In the Nimghavan Jeevanshala (boarding school for 100 children) there were 9 kerosene lamps and average expense of Rs 270 a month. Another Rs 150 for batteries.

All these kerosene lamps won't even generate half a unit (KWHr) worth of light in a month, and yet it costs a rural household Rs 65 a month..... thus the rural people pay 50-100 times more per unit of light than the city people.

What inspired this work?

When we were travelling in the tribal villages in Andhra Pradesh and in the Narmada valley we saw that little children were studying late in the night -- as late as 9-10 PM in Non-Formal Education centre's in AP and till midnight even

in Jeevanshalas or boarding schools run by NBA. Since the entire village was dark these children would share one oil lamp between 5-10 kids and read in that light. Moreover the very people who were being displaced by the dams for the sake of hydropower were people whom the government decided to leave in darkness -- that there were lights in rehabilitation sites mattered little as there was no land in these sites for farmers to have a livelihood -- so no one was willing to move.

Who should use Pedal Power?

Certainly village schools and NGOs will be driven by the need. In addition this is a very good educational device for the city schools because children should learn how easy it is to be self-reliant and how simple it is to start tackling the enrgy problem. People in cities should feel happy to try alternatives in solidarity with the poor, and have a change in life-style.

What are the future directions and other projects?

In pedal power we want to try LED lights. More work is needed in the front of batteries. For example, circuits that switch off when battery power is low and prevent over-discharge need to be made and more easily available in rural areas. Every village has at least one government subsidized solar panel that is usually lying in dis-use or under-use. This has to be addressed.

Alternate energy has to also be connected with local livelihoods. Solar PV technology is high-tech. and not much use for villages or even small cities in terms of generating livelihoods there. On the other hand things like pedalpower, windmills, biodiesel run engines can generate employment at the level of towns. Also electricity must not be equated with energy and there can be number of initiatives that directly use the energy for water pumping etc.

Finally...In a nut shell...

15-20 minutes pedalling in the day allows you to light up a room for 1 hour in the night. Want to get one?

Pedal Generator in Action...

A pedal power generator, aka Bijli Bike allows satyagrahis to power thier own lights.15 minutes of pedaling will run one 11 W compact fluorescent light (CFL) bulb for an hour.A product of Association for India's Development(AID)'s project in India.

Shown here is an 11 W compact fluorescent light (CFL), the first ever in the tribal villages in the submergence zone. 15 minutes of pedaling will run one bulb for an hour.

Rukmini kaki at domkhedi satyagraha with her flashlight off while Ashutosh pedals, generating light much more cheaply than using batteries or kerosene lamps.

An adivasi farmer from turkheda (Guj) who along with 4 other families is considering buying the pedal generator.

For more info.
On Pedal Power: aid@vsnl.com

on Bio-Mass/Bio-Diesel: vriyer@bom8.vsnl.net.in
Like the charka is for our clothes the pedal powered generator is for energy. It is a way to be self-reliant and bring livelihoods to the rural areas.

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Association for India's Development. P.O Box 149, College Park, MD 20741, U.S.A

info@aidindia.org

Rashron Energy and Auto Ltd
Business type: manufacturer, exporter, research institution
Product types: electric bicycles, solar cooking systems, wind turbines (large).

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Telephone: 0265 643224
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Western Technology Development
Contact Rashron Energy and Auto Ltd
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Vadodara 390010 ... Gujarat state .. India..
Fax 0091 265 643778 .... Phone 0091 265 643224 and 643289 ....
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Model P4

Charge a battery using muscle power.

Useful in villages for lighting in absence of electricity and exercise at home .
By pedalling for half an hour,

	one can use a 13 Watt CFL for 2 hours.

	Model P6

Same as P2 with a bike type sitting style

Tech Specs

Suitable for 12 volt batteries from 12 Ah to 36 AH rating. Smaller batteries get charged faster.

Nominal charging current 6 Amps.

Pedalling speed range: 60 - 90 rpm

Models for 6 volt batteries also available. (P3 and P5)

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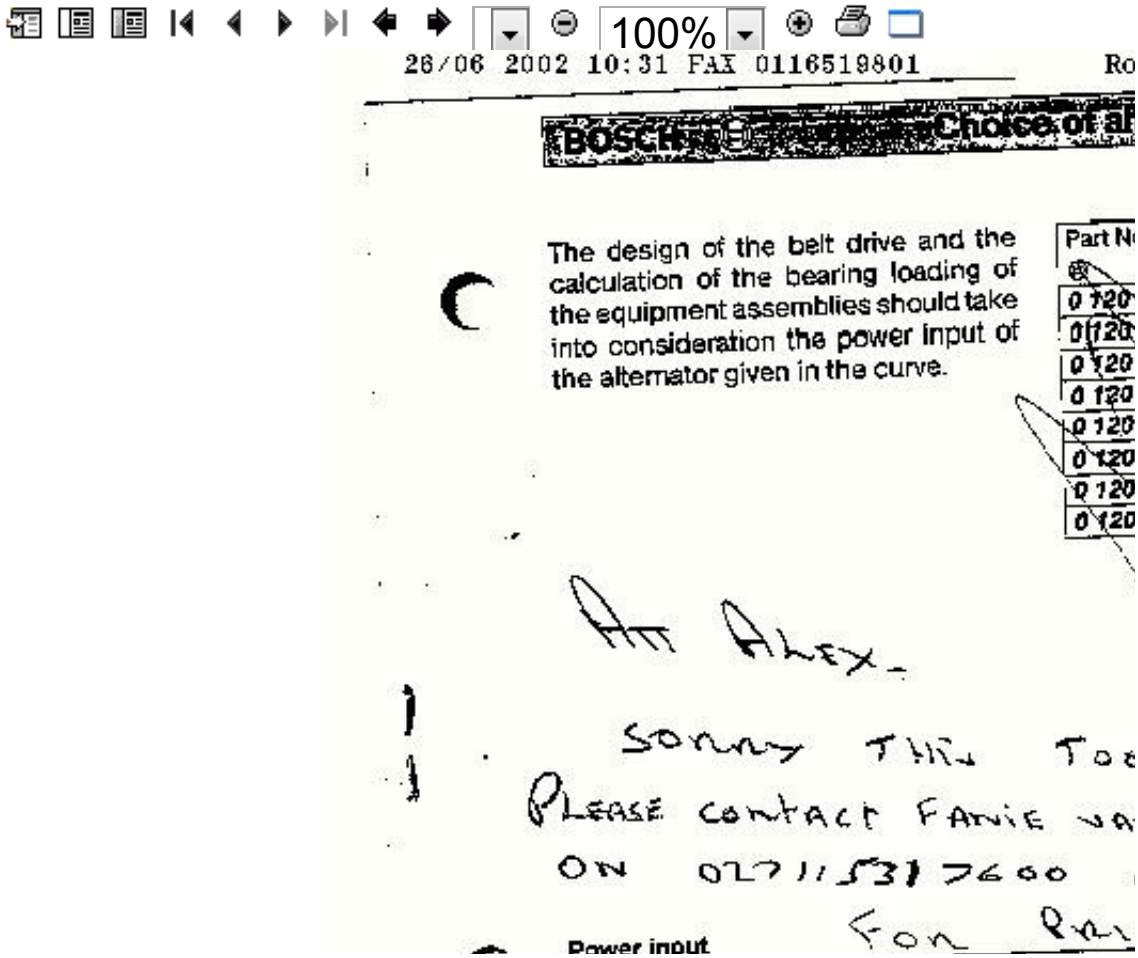
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The design of the belt drive and the calculation of the bearing loading of the equipment assemblies should take into consideration the power input of the alternator given in the curve.
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PEDAL GENERATORS

A collection of material searched around mid-2002

Some investigation was done by Alex Weir on suitable automotive (car) generator for use with 4-man pedal system. The Bosch 9 120 690 170 - a 55 amp alternator-generator appears suitable. Driving speed would have to be approx 3500 rpm, which is attainable by using 60 rpm drive through bicycle sprockets to a 200 rpm payshaft with a 600 mm diameter driver pulley and 'eaton vee belting' hollow flexible plastic belt drive to a 35mm wooden or similar pulley.

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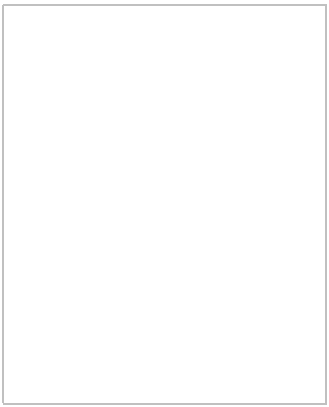


Pedal Powered Generator

http://www.los-gatos.ca.us/pedgen.html

A 36" particle board disk with a groove routed in the edge serves as the flywheel and

crankshaft for the permanent magnet 36 volt DC motor (1 2) seen at the upper right edge of the device. A small-pitch chain provides the power transfer system. The groove around the outer edge is lined with "rim strips" - thin rubber straps that prevented the chain from slipping and digging into the particle board. They are standard bicycle parts. The motor was obtained around 1985 from Northern Hydraulic, now known as Northern Tool and Equipment Company.

The bottom frame is welded steel plate and channel, the crankset is an American Schwinn ball bearing set, a cotterless crank conversion spindle, alloy cranks and cheap pedals with toe clips.

The crankset has a steel chainwheel on it. I drilled some larger holes in the chainwheel and bolted the particle board disk to it. It was strong enough (fine Schwinn steel!) to hold the weight of the particle board disk and run true. I routed an oblong hole through the particleboard disk for the "arm" of the crankset.

The seatpost and handlebar tube are standard galvanized water pipe. The generator/motor is mounted on a piece of 3/4 plywood visible in the motor pictures seen above, which is then bolted to the water-pipe frame.

The particle board disk is a key feature of this unit. The weight of the disk serves as an

excellent flywheel. Human legs and pedals create an extremely "peaky" torque curve, resulting in jerky motion and lots of stress on parts. The flywheel smoothes this all out by absorbing part of the energy on the power stroke, lowering peak torque, and releasing it on the "dead" part of the stroke, creating torque where human legs/pedals cannot generate any. Another thing to remember is that human legs do not like extreme stress. The flywheel allows the human to avoid having to generate extreme pressure during the power stroke just to make it past the "dead" spots. Many "bicycle converters" lack the flywheel characteristic because tires/rims are designed to be so light.

Noisy but extremely efficient, I have powered 12V **CHAIN SAWS** directly (yes, while someone else cut wood with them) with this unit.(1) Pedaling position was similar to a bicycle. The seat is barely visible at the upper left of the photo, and the handlebars (dropped, as on a ten speed road bike) are at the upper right.

Burst output: 25 amps at 17 volts (425 Watts)

30 minute average output (back when I was in shape) 150 Watts

Accessories:

A drill chuck threaded into the end of the motor shaft provided power for a flexible shaft

drive. Drilling 1/2" holes through 2x4 fir with this arrangement was easy. The flex-shaft was rated at 1/2 HP (a commercial unit, about 3/4 in. thick - not a "dremel" type!!) and I was still worried that the torque would be too much for it.

For immediate electrical use, cigarette lighter outlets provided ready access to the juice. I even had a small 12v toaster oven, and pedaled my bagels to toast more than once. For storage I would charge a 12v 100Ah fork-lift battery. I could approximate the output of a 10 amp battery charger.

Be careful - I burned out several expensive 12v halogen bulbs powering them directly. I had no voltage control and exuberant pedaling would fry the bulbs in short order. When the storage battery was connected, this was less of a problem because the battery tended to even out the voltage, but sprinting would still raise the voltage to the danger level.

At one point a ball-bearing 3600 GPH pump was substituted for the generator, resulting in amazing water pumping capacity. The suction from the pump was strong enough to collapse the heavy wall 1 inch vinyl tubing used for the intake (radiator hose would have been better, with the wire reinforcement) and the output shot a stream of water about 25 feet across the street. A 5 gallon bucket was emptied using this pump in less than half the time it took a garden hose to fill it. I believe the pump was driven to capacity (1 gallon per seconds, emptying the bucket in five seconds) in sprints.

Instrumentation consisted of a voltmeter and an ammeter, which together provided me with state of battery charge, output watts and somewhat of a "speedometer." The math was easy: **VOLTS x AMPS = WATTS**. A 50 amp silicon stud diode mounted to a four inch square piece of aluminum sheet metal prevented reverse current flows, and became satisfyingly warm after long sprints (it is mounted in the center of the aluminum plate visible in the first motor picture). For top efficiency (and safety), a switch was also installed to completely isolate the diode and motor/generator from the battery.

I never had a chance to determine how efficient the unit was in converting mechanical energy to electrical energy, but I believe it was probably quite good. When running, only 4 ball bearings were turning, the only high-speed part was the armature of the motor, and I know from research that chains can be as high as 97% efficient in power transfer. The permag motor was probably better then average at power generation, because it was designed to be efficient as a motor. In "reverse" tests, with the motor driving the unit with no load, the power consumed was less than an amp at 12 volts. This is negligible, and much of it was resistance loss in the motor windings, since the motor drew half an amp with no load connected to it.

Status: The device out-lasted me. I still have the motor and flex-shaft, but several job-related moves finally forced me to dismantle the unit.

Future: There are many other possibilities that I can think of for this device. The efficiency and variable speed of the output are two features that can be exploited. Here are some other devices that could be powered by the basic unit:

- Pedal powered backup generator for solar electric systems. With the newly available white LED as a light source, a few minutes of pedaling would be enough to create hours of light.
- Pedal powered washing machine (this would be a tremendous workout, especially with the spin/sprint at the end!)
- Pedal powered clothes dryer (when combined with a simple solar hot-air collector, the pedals would tumble the clothes and move the air)
- Pedal powered whole-house ventilation fan (15 minutes in the evening to cool off an entire house)
- Pedal powered watering system when combined with a cistern to store rainwater
- Pedal powered whole-house (central) vacuum cleaner - requires two people, of course
- Pedal powered air compressor (compressing air takes a LOT of power, and is not very efficient. This would work for small jobs only, like staple guns, caulking guns, small hand tools - no jackhammers!!)
- Pedal powered offset printing press, sewing machine (an ancient idea), hand tools (grinder, buffer, drill, reciprocating saw, lathe), mulch grinder

Basically, any device that was hand cranked, foot-powered, or powered by a fractional horsepower electric motor could potentially be converted to pedal power.

Also note, if the base unit is being used to power an auxiliary device instead of producing electricity, adding a solar panel will result in additional power from the motor! That means whatever device you are powering would receive the **combined** power of the human pedaler and the solar panel. This combination makes the best of both power sources, as efficiency would be very high, because the solar output would not suffer the losses of being stored and then extracted from a battery. Charging a battery and then extracting the same power is less than 80% efficient, and can be much worse. Direct utilization captures that wasted power.

Finally, keep in mind that a **tandem** setup for the pedals, with the pedals out-of-phase, doubles the power and smoothes out the power flow. Only one "flywheel" is needed, so this enhancement needs only a simple pedal/seat addition to the basic unit. With out-of-phase pedals, peak torque is not increased, so other parts of the system are not stressed. The torque curve for a complete revolution of the flywheel simply smoothes out, while RPM's stay constant, resulting in twice the power.

Over time, a number of questions have asked about the information on the page. Here are some Frequently Asked Questions and answers/opinions:

Do you have plans available?

No. I am working on drawings of this generator and a recumbent version, but they are not yet available.

Would a car alternator work better for generating power?

No. Most automotive alternators have one ball/one sleeve bearing, a built-in power-robbing cooling fan, and they require external power to excite them at low- to moderate RPM's. They have never been designed with efficiency in mind, since they were attached to monstrous motors capable of producing orders of magnitude more power than the alternator required. They actually produce AC power, which subsequently must be rectified to DC to charge batteries. This step causes significant power loss in the diodes (around 5%). As I noted above, I ran power output around the diode and directly into the battery to avoid this loss. In addition, alternators are designed to run at extremely high RPM's (alternator pulleys are smaller than the driving pulley on the engine, meaning the alternator turns FASTER than the car engine. Look at your tachometer reading and double it. Whew!), and do not produce usable power until they are rotating quite rapidly, requiring high ratio's of step-up from your pedals. A well-designed permanent-magnet ball-bearing motor, preferable one designed to squeeze every last bit of power out of a set of batteries, will beat an automotive alternator in efficiency.

Wouldn't gears help generate more power? And what about belts instead of chains?

Maybe. Humans can only pedal through a small speed range, about 40-120 RPM's. Below that you can strain your joints, and above that efficiency falls off. There is a "magic" speed (different for every human being) at which they can generate maximum power. The proper gear ratio enables the human to pedal at that speed. You may have noticed, though, that a human's maximum power output can change quickly from fatigue, and slowly from changes in conditioning and age. The magic speed is always changing, so having a few closely-spaced "gears" or ratios may enable a better match of human to generator. No matter what, though, **gears don't create energy, they waste energy**, so having fewer of them is always better. The same goes for bearings, even ball bearings. The pedal-power generator described on this page had very few of both, so it was very efficient.

Regarding belts, the transfer efficiency of most belts is less than chains. This is mostly due to flexing energy loss within the belt material and friction losses at the engagement points between the belt and the pulleys. Belts also work best when transferring low torque at high speed (the opposite of what a pair of legs produce!) which is why you do not see them on bicycles, for example. There may be some exotic, thin, high strength belts that could approach the efficiency of chains with the right design. For example, the "serpentine" belts used in modern automobile engines are much more efficient than the old "V-belts" from the past. Belts rely on friction to

transfer power. Friction is bad. The best feature of belts is that they are *quiet*, so I can't say to avoid them completely. If you decide to use a belt to transfer power, use the thinnest, strongest belt you can find, and place only enough tension on it to keep it from slipping during use. I do not know whether equivalent "toothed" and "grooved" belts are equally efficient, but I believe the toothed belt has slightly lower friction losses. If I can ever find some real research data on the web I will link it in here.

How much power can one human being create?

This is an opinion. I used to be a competitive swimmer, and for a number of years, I worked out 6 hours a day, swimming approximately 13 miles. Yes, 13 miles a day. If you pedaled that hard for that long you might be able to run one ordinary refrigerator for 24 hours. To make any kind of significant contribution to your energy supply, you must use the most efficient devices you possibly can. For example, a small refrigerator designed to be powered by solar power would be much more practical. A rule of thumb: if the device was designed to be powered by batteries, even BIG batteries, you might be able to keep up with it.

If your electric bill shows KWH (kilowatt-hours), take the number, multiply by 4 (assuming you can crank out 250 watts for an hour) and that is how many hours you will have to be in the saddle to create the same amount of power. Sorry, it can be

depressing. The moral: **Using less power is as important, if not more important, than making more.**

There are numerous sources of efficient appliances on the web. One place I like to shop is Real Goods, and of course I have spent time inventing my own efficient devices. The white LED light I built shows how technology can create new solutions to increase efficiency. Pedaling for an hour at the 200 watt pace, with 80% efficiency of generation/storage/extraction, would create enough energy to run that light for **320 hours!!!**

Can I generate 110V? Can I run my electric meter backwards?

I don't recommend this! If someone were to replace the permanent magnet DC motor in a pedal generator (such as the one on this page) with a 1/4 to 1/2 horsepower 110V **induction** motor and pedal that it would result in an amazing thing. If the motor was hooked to the power lines and it was "pedaled faster than it wanted to go", it would start generating 110V alternating current. Beautiful sine wave AC. If it was creating more energy than your clocks, refrigerator, all those little square black power supplies you have plugged in around the house, your lights, and that 300 watt stereo you are listening to while you pedal all use together, your electric meter would slowly creep backwards. However, that same motor would generate exactly

0 power if it is not plugged in to 110V AC.

For very light duty "off the grid" use of 110V AC, you can try pedaling your 12V DC generator into a large battery and hooking up an inverter (12V DC - 110V AC) to get some pretty decent 110V power. You CAN'T use this method to "run your meter backwards"!!!! In general, plan on being able to pedal about 100-250 watts for half an hour or so.

For efficiency, however, **you are much better off producing 12V DC for a 12V DC TV (for example) than you are producing 12V DC to charge a battery to run an inverter to power a 110V AC TV**. The UPS (uninterruptable power supply) for my website computer system can power the computer for about five minutes. The same battery (12v 1.5 AH) would power my laptop computer for about 45 minutes. Everything (efficiency-wise) works FOR you when the device being powered is designed to be efficient (12V DC) and AGAINST you when it is not (110V AC).

How big should my batteries be?

If you are considering building a similar system, plan on using two batteries, and a simple switch which allows you to use one while charging the other. Flip this switch right before you begin charging to ensure that you are charging the battery

with the lowest charge (the one most recently used). Also be sure to use a battery that is roughly equal to ten or twenty times your power output for a charging session. For example, if you crank out ten amps for an hour each time you charge, choose a 100-200 amp hour battery. Larger batteries will simply loose charge through self-discharge faster, resulting is less efficiency for your system and more useless work for you.

Remember:

1. The **most efficient** way to use the power you create is not to create electricity at all, but to power your (pump, fan, hoist, winch, drill press, grinder, sewing machine, etc.) directly.
2. The **second most efficient** way to use the power is to pedal a generator to electrically power your (television, radio, floodlight, chain saw, laptop computer) directly, with no battery. Be careful about voltage, or use a good regulator.
3. The **least efficient** way to use your power is to generate electricity and store it in a battery, then extract it from the battery to power some device. Avoid this method in favor of methods 1 and 2!!

For more information, read this excellent writeup giving details on a different design

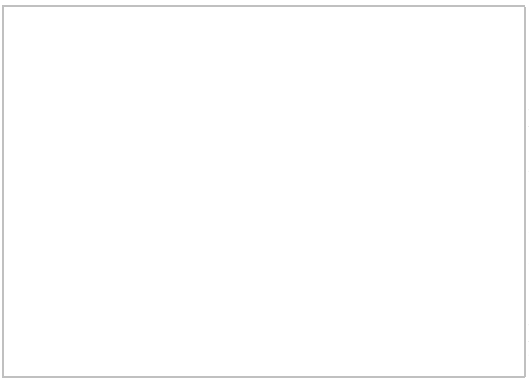
based on a bicycle and rollers. .

(1) Three things about the chain saw. One, I was in great shape and probably was generating over one horsepower in the sprint. Two, the branch/log was about three inches in diameter - not anything near the 14 inch bar length. And three, the saw was a 12 volt saw, so it was designed to be efficient. The literature from the saw said that the motor was a permanent magnet Bosch electric winch motor, which was a good match for the maximum output of the pedal generator. It was great to see the chips fly!

Back To: [David Butcher's Personal Page]

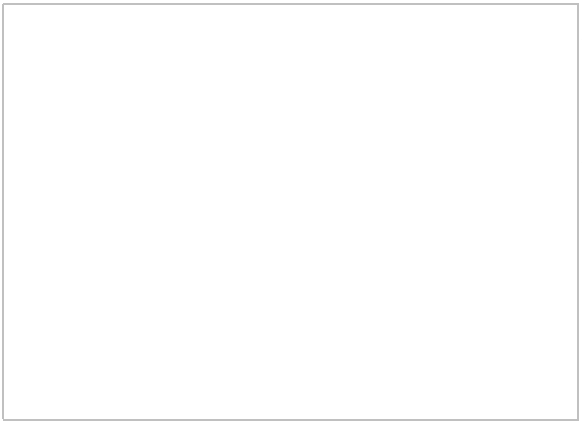
http://users.erols.com/mshaver/bikegen.htm

Bicycle Powered Generator



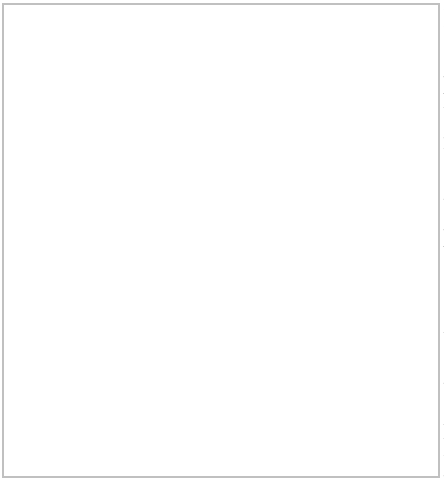
I skim a few Usenet newsgroups daily, among them misc.survivalism and alt.energy.homepower. Frequently posters on these two groups will inquire about generating electricity using a stationary bike coupled to some sort of generator. Most replies are to the effect that while it's possible to do this, the amount of power output by such a rig when pedaled by the average person wouldn't be worth the effort. I wasn't convinced that this idea was a lost cause. I decided to build one and see how well it worked.

Because bikes are made in a range of sizes to match their rider's stature I wanted to build the generator as an accessory which could be driven by any ordinary bicycle. I used to work in a bicycle shop when I was 13 and remember seeing the owner, Mr. Hank, ride his track bike on a set of rollers. While I was looking through bike accessory catalogs for rollers that I could adapt to my purposes I came across another similar device called a training stand. While rollers require a lot of skill to ride because there is nothing but the gyroscopic force of the spinning wheels and the rider's balance to hold you upright, a training stand clamps on the rear axle of the bike and keeps you vertical.



To make a long story short I bought the most versatile training stand I could find and then did extensive modifications to the roller assembly. Originally the ball bearings were pressed into the bore of the roller at the outer ends. The roller assembly spun on a stationary axle fixed to the frame. The end of the roller, opposite the integral three pound flywheel, drove the hub of a centrifugal clutch. The shoes of the clutch engaged a stationary drum which provided resistance increasing with speed. I had to make a new axle which is locked to the roller and move the bearings to machined aluminum plates outboard of the steel frame. The plates are made to a standard NEMA 42 size and provide the mounting surface for a permanent magnet DC motor that is driven as a generator through a flexible coupling. The other end of the axle exits from the bearing through an identical plate and is available for PTO use. You can see a black sprocket on that end of the axle in the

pictures. I also had to weld in a brace to stiffen up the frame to allow carrying the extra weight of the generator. I'm pleased with the result. Even under heavy load it runs cool and relatively friction free. The part of the frame that clamps to the rear axle of the bike pivots with respect to the ground so that the rider's entire weight forces the tire into contact with the roller reducing slippage to a minimum. The black object under the front wheel is a contoured plastic block that levels the bike to avoid the feeling of riding downhill.



I have done quite a few tests to see how much output power could be produced and what practical applications there were. See the tables below for a list of those tests and the results. In summary I think the most practical application of the bicycle powered generator would be battery charging. This application presents a constant load to the rider which allows them to select a single gear ratio which lets them pedal at their optimal cadence. Another practical application is running small appliances and tools which use universal series wound motors or permanent magnet DC motors. All of the motorized items in the table below have universal series wound motors and would run on DC even though their nameplates all said "120 Volts AC Only". Induction type motors such as those found in washing machines and shaded pole motors which are used in clocks really are AC only and won't work at all. I couldn't get my variable speed drill to work, probably because the speed control electronics are incompatible with DC. Good candidates are appliances or tools that can

perform their functions with 300 watts of input power or less and which present a narrow range of loads such as the mixer and electric drill. Although producing heat with electricity is usually a bad idea, I think that small soldering irons might also work well since they are almost all are under 100 watts and most are less than 50 watts. Since there is no voltage regulation at all, connecting the generator output directly to the power input jack of battery powered TVs, radios, and similar devices will probably destroy the sensitive electronics. Use the generator to charge the batteries, and power the electronics from the batteries. Since the generator is capable of outputting several amps it may be best to charge only batteries that can accept a charging rate in this range, and then building an efficient switchmode regulator to charge smaller cells and batteries off of the large battery. The final, and as yet unexplored, application is hitching mechanical loads such as a water pump or grain grinder to the PTO end of the axle using roller chain. I expect a lot more useful work out of this arrangement as it avoids the inefficient conversion of the rider's mechanical energy into electricity and then back to mechanical energy via electric motors. Using 27" tire diameter on the bike and a 10 MPH "road speed" the roller will turn at about 2600 RPM. The sprocket shown is the smallest I could find at 9 teeth for 1/2" pitch #41 chain, so you would need to figure from there what size sprocket you need on the load to give the desired load RPM. One suggestion that came up during testing was to drive a heavy flywheel to dampen out electrical load variations, but that was never tried.

Electrical Tests:		
Load	**Output**	**Comments**
Open Circuit	230 Volts DC	Spinning it as fast as possible in the highest gear that the test bike had and measuring the output with a DMM.
Short Circuit	4 to 5 Amps DC	Generator output shorted by the DMM on the 20A DC scale. This measurement doesn't mean much because it took a lot of torque to turn the generator against a short circuit. It was hard to get consistent readings due to the speed fluctuations from the low rate of pedaling that could be achieved.
2 Ohm Wirewound Resistor	5.5 to 6 Volts DC (15 to 18 Watts)	This test had the same problem as the short circuit current test, the load impedance was too low to allow the rider to pedal effectively.
65 Ohm Wirewound Resistor	100 Volts DC (150 Watts) Continuous, 130 Volts DC (260	The continuous figure is what the rider felt he could keep up for 15 to 30 minutes. The peak value was a few second burst of speed.

	Watts) Peak	
100 Ohm Wirewound Resistor	100 Volts DC (100 Watts) Continuous, 150 Volts DC (225 Watts) Peak	The difference between this test and the previous one could be variability of effort on the part of the rider, perhaps as a result of fatigue. Another possibility is impedance mismatch between the source (generator) and load. The generator has a very low output impedance and the ideal load would be the lowest resistance that will still allow the rider to pedal at an effective rate.

Practical tests:

Load (Nameplate Data)	**Results**	**Comments**
Battery	Great	Able to push a continuous 4 to 6 amps into a 12 Volt automobile battery. The best setup was to put a rectifier diode in series with the generator output. This stopped the battery current from driving the generator backwards and enabled the rider to start pedaling

Charging		without any initial resistance. It was then possible to take up the charging current load gradually as the generator output exceeded the battery voltage plus the forward voltage drop across the diode.
Waring Multispeed Handmixer	Good	Moderate pedaling effort was required to run this appliance up to operating speed. I loaded the motor by trying to slow the rotation of the beaters by hand. There was plenty of available torque to use the mixer in its typical applications. I'm certain that similar appliances such as blenders and food processors would work just as well.
Black & Decker 3/8" Drill Model 7104 Type 1 (2.9 Amps 1200 RPM)	Fair	Lots of 1/4" holes were drilled through a 2" thick piece of framing lumber with a standard high speed twist drill and I'm sure that larger holes would be possible. The only special consideration was to ensure a steady feed rate while drilling to avoid load fluctuations.
Black & Decker 7-1/4" Circular		Considerable pedaling effort was required to get the saw up to operating speed and it bogged down to a standstill when a cut through a 2 x 4 was tried. We might have been able to cut 1/4" plywood or luan. I think the problem is that the motor in this tool is designed for maximum power output regardless of conversion

Saw Model 7308 Type 5(1-1/2 HP 9 Amps 1200 RPM)	Poor	efficiency. I'm sure a person has enough power to saw a board, after all, I can do it with a hand saw using only the muscles in one arm! I would like to try this test with a saw designed to run efficiently on DC such as the battery operated ones made by DeWalt.
McCulloch ElectraMac Chainsaw Model EM14ES (2 HP 11Amps)	Useless	This tool's motor has the same characteristics as the circular saw. It was impossible to get it up to full speed, and the blade merely bounced off the surface of the log and stalled when any meaningful cutting force was applied. The nameplate claimed 2 horsepower and the motor's size was perhaps 3" in diameter and 6" long.

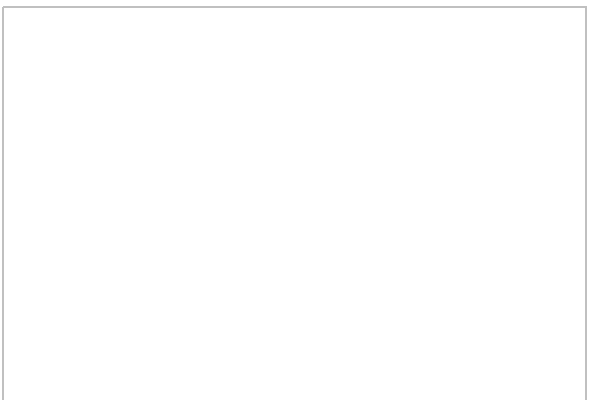
Acknowledgements:

During my "what if" phase of research on the internet I was directed to David Butcher's Pedal Generator page which provided me with the proof of concept I needed to justify building my own version of a bicycle powered generator. I think my results correlate well with his.

I would also like to thank my long time friend Mike who spent several hours with his Paramount mountain bike clamped in my contraption pedaling diligently while I measured and fiddled around. For reference he is in his mid 50's, in good physical health, a non-smoker and semi-regular recreational cyclist, so you can scale your own expectations accordingly.

The Pedal-a-Watt Stationary Bike Power Generator

- **An easy to build stand that will accept any bicycle**
- **Easily creates 150 to 200 watts at 12 to 20 volts DC**
- **Bicycle easily disengages from stand for immediate road use**
- **Stand folds easily for transport**



The Pedal-a-Watt bike was designed to keep the user aerobically fit while creating some extra power that may be sent to a bank of batteries. These batteries may then be tapped at a later time, after dark for example, when the energy is needed to power lights or appliances. The Pedal-a-Watt bicycle is an excellent addition to an existing battery system that may already be

charged from the photovoltaic panels, 120 VAC grid power or wind power. The concept behind the Pedal-a-Watt bicycle is that electricity can be created from human effort and then stored in batteries.

The average rider will produce between 150 and 200 watts using the Pedal-a-Watt. While this may not seem like much power, solid state equipment draws very little power and can be powered for long spans of time with small amounts of power. VHF/UHF Ham Radios, laptops, and DC stereos all draw small amounts of current at 12 volts DC. In addition, LED lighting and high efficiency fluorescent lighting now allow 200 watts to go a long way. A typical 25 watt fluorescent light bulb, which replaces a 100 watt incandescent bulb, will last 8 hours on 200 watts worth of power. LEDs (light emitting diodes) are even more efficient and will last days on 200 watts worth of power.

Any bicycle that is in good shape will suffice for mating to the Pedal-a-Watt platform. However, bicycles with wheels of larger diameters, such as 27 inches as opposed to 16 inches, create more mechanical advantage. Both street bikes, with very narrow, smooth tires, and mountain bikes, with wide, knobby tires, have been used with equal success. The bicycle is placed upon the stand, which is an Advent Mag-Trainer. It comes assembled and folds up easily for transport - even after the

alternator is added.

The parts cost a total of about $115 and are available via mail order. Our plans include all suppliers and part numbers needed to order each component.

If you have any questions, feel free to email me at Bill@econvergence.net.

Thanks for your interest,

Bill Gerosa Convergence Technologies, Inc. 19 Tioga Lane Pleasantville, NY 10570 914-773-6749 support@econvergence.net

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"The Bicycle Generator".Individuals or organizations read on...

The Bicycle Generator

NOTE {Sorry, we are no longer selling the bike generator/or video at this time.) I will leave up the info and pictures for public review. We are currently selling the hand powered dc generator that works off the same idea although it uses hand power, no bike needed. I just attended a show at the y2k expo in Pittsburgh were I was a vender, showcasing our D.C. voltage hand crank generator; that can power radios, lights , AC power tools, inverters or charge

batteries. Using our unit takes little effort and a child can power a clock radio at a very loud full volume with ease, turning hand crank very easy and slowly . 25 watts sustainable is very likely depending on user. Our unit is capable of much higher output requiring suitable driving force. Unit comes with two regulated outputs, a 13.5 volt 5 amp output and a 1.5 amp 5 volt output. You can drive our unit with a gas motor or with wind power if you modify our unit which is not to hard if you are good with your hands . Our generator motor is abile to output much more power than the human arm can develop, demagnetization occurs at about 13 .5 amps. Units are about 2ft by 2ft and about 15 inches high at highest point. the generator is priced to sale at $125.00 plus s&h} The following is related to the bike generator The bike generator will deliver approximately 30 to 40 watts with average biking effort(sustainable) and can deliver over 100 watts as biker increases effort. This will be great for charging Batteries or for running

lights or radio. Unlike windmill generator, It can work without wind. Unlike solar , It can work night or day, rain or shine. Unlike gas generators it works even when you run out of gasoline. I think this can be an option to fill in the generating or charging needs on demand after y2k and can suport the above power sources. I will offer the generator (regulated 13.5 volts or 14.5 changeable) and mounting that will hold the 10 speed bike. The user will supply the 10 speed bike (29 inch best). I plan to offer the units for an initial price of $150.00 to gadge public response. I am also selling a video tape of how to build your own Bike generator for $15.00+ S&H

What is 12 volts direct current (dc) good for? Well lets see, all small portable radios work off of dc voltage some have a plug that accepts 120 volts alternating current (ac), but changes it into a lower dc voltage that the radio can use. All electronics use dc voltage. You can hook 12 volts dc to an electronic device called an invertor that will change the 12 volts

to 120volts ac. Motors and portable heaters run best of of 120 volts ac. Motors use the rising voltage to help create changing magnetic fields to make it spin. Heaters can use lower voltage but most have electronic contol circuits designed to work with 120 volts (ac) plus the resistance of the niocrom wire is set and in order to get the rated heat out, the voltage has to be high enof to cause rated current to flow. Comments or questions?

I think you will really understand the value of our product if you perform this test. Go to your breaker box and turn it off. Now throw your car keys away since your are no longer able to use public roads since state of emergency was declared. Now stare at your family as they stare back or peddel your bike generator its your choice. While you still have a choice. <br Do you love animals? Would you like to promote a terrific product that helps protects animals. Then join our team of sales people selling The "Pet Flicker". Look through our pages and find out all you

can about my invention. If you think you can honestly promote our product I will ship two "Pet Flickers" to you at wholesale pricing. I suggest buying a "Pet Flicker" for your own pet first so you can see it's merrits, this is a darkness activated collar attachment that emits a continuous flickering light in the night. "Pet Flicker" helps to protect your pet from motorists in the darkness. "Pet Flicker" helps you to find your pet in the night. "Pet Flicker" helps motorists to see you when you take your pet for a late night or early morning walk. The 'Pet Flicker" makes a great gift idea for pets or pet lovers. Keep your four legged loved ones safe, buy them a "Pet Flicker" today!

If you are interested in our product
send us Email:
invent@brads.net
petflicker@angelfire.com

Home page "Pet Flicker"
Pictures of "The Bike Generator"

http://www.angelfire.com/biz/petflicker/page9.html

too slow to load = http://www.zetatalk3.com/energy/tengy05g.htm

The International Guide to Alternatives in Cycling

Compiled and written by Hannes Neupert of Extra Energy, a non-profit organization dedicated to promoting muscle-electrically powered vehicles.

Extra Energy, Koskauer Strabe 98 / D - 07922 Tanna, Germany

More Power To You

Gone are the days when the pleasure of cycling was inextricably linked with the not-so-pleasurable strain of hill-climbing or the tiresome grind in the teeth of a headwind. Today we can choose how hard we work, thanks to a new genre of vehicle, the pedelec. This ExtraEnergy section of this years Encycleopedia gives just a brief glimpse into what may become a new renaissance for pedal-power in urban transport. The new technology offers the opportunity for whole new sectors of society to rediscover human-powered mobility, thanks to pedelecs which bring the comfort level of

"The Rabbit Tool bike is an excelle of a vehicle to be conjunction with modes of transpo Rabbit Tool hub

cycling up to the level expected by todays consumers. That this is a reality, rather than some optimistic fiction, is proved by a look at the sales figures for 1999.

Worldwide, 500,000 pedelecs and e-bikes were sold: 200,000 pedelecs in Japan, 200,000 e-bikes in China, 40,000 pedelecs and e-bikes in Europe, 40,000 pedelecs and e-bikes in the USA and 20,000 pedelecs and e-bikes in the rest of the World. In this Encycleopedia we show a few examples, which fall more or less into the various categories proposed by ExtraEnergy. SRAM are the first to launch into the easy-pedelec category with their Sparc. The Lafree fulfills many of the comfort-pedelec criteria admirably. The flyer exemplifies the potential of a sports pedelec. The Heinzmann Estelle embodies the properties of an e-bike - but is also available as a pedelec. The Heinzman drive is also very suitable for the practical creation of load-carrying pedelecs. The Rabbit Tool folding e-bike is an excellent example of a vehicle to be used in conjunction with other modes of transport. The Rabbit Tool hub motor is also

also particularly s
use in multi-track
carriers and spec

-Hannes Neu
Extra Energy

Rabbit Tool

O.J. Birkestrand h
mechanical engine
making small mac
Illinois, USA, and
developing the ele

particularly suitable for use in multi-track load-carriers and special bikes. The Lynch motor system also opens up interesting ExtraEnergy, the German-based international organization which promotes human/electric vehicles, divide electric bikes into two categories:

Pedelec: The power comes on when you pedal. Its like cycling with a tailwind. The power of the motor assist is coupled to the effort of the rider using a force or motion sensor. Because the motor is only active when youre pedaling, the human power element is always dominant. Pedelecs, which Yamaha first brought to market in 1994, have the potential to create a new generation of personal transport, which rides like a bicycle, yet is as comfortable as a motorbike.

E-Bike: Hand-control of the throttle. On an e-bike the motor power is regulated using a twistgrip or knob, as on a moped. Muscle and electric power are completely

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allowing for wider

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(motor, battery, thr

independent. E-Bikes can be ridden both in purely electric or muscle/electric modes. E-Bikes tend to be more like electric mopeds than bicycles. The trend is to ever-increasing motor power, and this tends to dominate the human power element.

Pedelecs for all

Car buyers can choose from a wide range of types: Limousine, van, sports car, cabriolet, pick-up. In the future you will be able to choose a pedelec to suit your exact needs in just the same way. Here we show five examples of how pedelecs might develop in the future.

Easy Pedelec

If you find walking hard going, and cycling is too strenuous, then easy pedelecs offer a new chance at mobility and recreation. Speed and range are suited to shopping trips or convivial day-trips of 20 to 30Km. Weight should not exceed 18 to 20Kg. The easy pedelec rides like a normal bike, but

much easier - Its like a built-in tailwind!

Comfort Pedelec
The comfort pedelec is the vehicle for business users, everyday commuters or occasional riders, and also for day rides. Comfort and riding fun, and not traffic jams or parking problems, are guaranteed with a comfortable saddle, full suspension, lockable luggage box and other features. An infrared security system protects from theft. The extra weight of this comfort equipment, which would otherwise make hill-climbing hard, is compensated for by the electric motor. A partial or full pairing could also be added. You can start your working day fresh, not sweaty. After work youll pedal away happily instead of going to the gym.

Sport Pedelec
Sport-oriented and trend-conscious young people will embrace the sport pedelec as a new fashion, which is also most suitable for everyday use. Speeds of 35Km/H and

more in combination with individual, dynamic design and corresponding branding bring image, fun and fitness.

Load-Carrying Pedelec

The load carrying pedelec is equipped to carry loads of all sorts. The vehicle is highly powered, so that steep sections can be overcome even with a full load.

Race Pedelec

The race pedelec is designed for high speeds, with an aerodynamic shape for low wind resistance, low weight and exclusive design. Its attractive racing image makes this an important showcase for pedelec technology.

At just 16kg, the Rabbit Tool EX-Bike from the USA sets new standards for an e-bike. Using an aluminum frame from Dahon and their very compact alternating-current motor/generator, Rabbit Tool has developed this bike as a showcase for their motor technology. Its a commuter vehicle

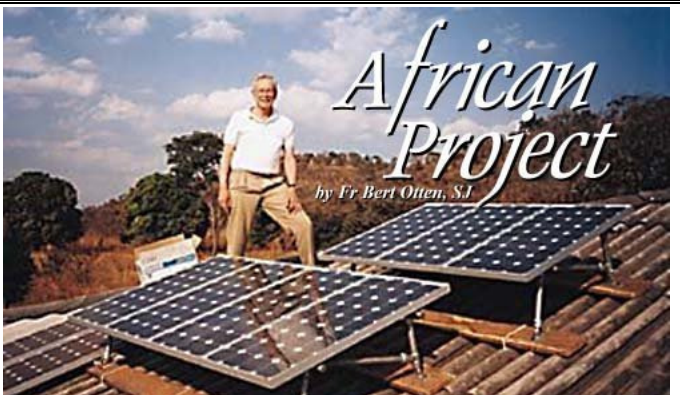
for short distances, to be used in conjunction with other modes of transport - hence the focus on a minimum-weight design. A backpack bag from Dahon makes trips by bus, air or train hassle-free.

The motor is a gear-reduced brushless AC design with a continuous rating of 300W. The range goes from the standard front and rear wheel versions to an ultra-compact design which, including the tyre, gives an 8 wheel, suitable for, for example, wheel chairs, lawn mowers, hand carts or industrial applications. The variant with one-sided wheel support and integrated disk brake is unique world-wide, and is ideal for multi-track recumbents, transport bikes or trailers. The motors are up to 95% efficient in a wide range of conditions - Rabbit Tool is delighted to provide technical details. Different windings are available to suit the torque required.

The motor also offers the possibility of electric braking, and regenerative braking at very high efficiencies - feeding

current back to the batteries when going downhill or reducing speed. This patented technology opens up exciting new possibilities for the manufacturers of e-bikes and pedelecs: regenerative braking is powerful enough to make normal braking a rarity, only needed in emergencies, and it has the potential to greatly extend the range of electric vehicles. It also confers independence: prop the rear wheel off the ground, and pedaling will re-charge the batteries. It could also be used to generate stationary power - ideal for camping.

The 7 or 13 Ah nickel metal hydride batteries are contained in close-fitting aluminum tubes, for optimal dispersal of the heat generated during the charging process. The standard charger takes two hours, and is designed to sense the state of the batteries, using smart charging to greatly extend battery life. It is contained in a metal casing the size and shape of a drinks bottle, so it can be easily transported. A one-hour charger is under development. The batteries can also, of course, be solar-recharged.



Electrical engineer Fr. Bert Otten, SJ, designed solar panels for a Jesuit Refugee Service office in Angola, far from his usual Seattle haunts.

In July 1997 I was in Africa,

a place I first visited a few years ago on sabbatical from my duties as professor of electrical engineering at Seattle University. When the opportunity for the sabbatical came, I had to decide how to use it. Was I going to continue some astronomy work I had been involved with at the Vatican Advanced Technology Telescope (VATT), or should I follow a dream I had had for many years: using my training to develop solar energy technology in a foreign mission setting?

I had entered the Society of Jesus back in '53, intending to major in sociology or serve in foreign missions. That part of my vocation was inspired by working at summer camps for inner-city children. But early in my studies I did well in electrical engineering and enjoyed it, and I followed the invitation of Fr. Victor Blum, SJ, engineering dean at St. Louis University, to continue in it.

During most of my Jesuit life I have been involved in teaching electrical engineering at St. Louis University, Missouri University in Columbia, Rockhurst College in Kansas City, and now Seattle University. I have enjoyed the hundreds of EE students with whom I have worked in class and

on projects. It is rewarding to help them develop an understanding of nature, learn to design something useful, simulate it on a computer, and then build it.

Engineering has also gotten me involved with interesting projects. I have journeyed with seismologists to the bottom of a lead mine in Missouri to set up a strain extensometer that would measure earthquakes in the New Madrid fault. I have worked on a Jesuit shortwave radio network that linked remote mission stations in Honduras. I have collaborated with Vatican Observatory astronomers in Tucson and at Castel Gandolfo near Rome on the design of telescopes and instrumentation. I have even gathered data for asteroid light curves at an observatory at Mauna Kea in Hawaii.

After a bit of prayer and the realization that I was in my early 60s, I decided that I might not be able to walk by the time my next sabbatical opportunity came. If I wanted to do solar work and appropriate technology in a developing country, it was now or never.

I teach at Seattle University in the Jesuits' Oregon Province; it works closely with the Jesuits' Zambia-Malawi Province in Africa, which operates the Kasisi Agricultural Training Centre (KATC) in Zambia.

KATC's technology workshop was a natural place for me to head.

In Zambia, as all over Africa, deforestation and desertification are big problems. Most people use wood for cooking, butting up five-inch-diameter logs in a "star" fashion. As the fire burns, the cooks push the logs toward the burning center. In addition, many people make their living turning trees into charcoal for sale in the cities. Wood is being used up rapidly; in Katondwe, Fr. Joseph Olewski, a Jesuit I was visiting, had to haul it from three miles distant.

KATC teaches sustainable agricultural techniques to make life in the villages more full and satisfying. We introduced five designs of solar box cookers (we even cooked cornbread in demonstrations) in the hope of eventually taking some stress off the supply of trees. The heat these cookers generate is also enough to pasteurize water, and this helps attack intestinal diseases, which contribute to the high infant mortality rate in Africa.

The solar cooker was just one of our projects. Using a large cylindrical parabolic mirror, we were able to use sunlight to produce steam to power a small irrigation pump. We worked with photovoltaic solar panels to produce electricity for homes and a hospital. We repaired radios, cassettes,

and TVs. For a few folks fortunate enough to have electricity in their homes I repaired stoves and refrigerators, and I also became adept at fixing the electrical systems of tractors and water pumps.

After the sabbatical was over, I returned to Seattle University, wondering how to connect the talents of students in a sophisticated First World engineering program to the needs of people in the developing world. With financing from my Francis P. Wood, SJ/Boeing Chair in electrical engineering, I sponsored a year-long senior design project exploring ways of bringing electricity to a thatched-roof village home. Electrical engineering student Cynthia Gilbert came up with a way of shorting out bad cells of old auto batteries so that the remaining cells are useable. Phil Stewart, another EE student, designed a mechanism for rotating solar panels to follow the sun, while his classmate Mohammed Al-Jassar worked up a regulator circuit for use with the panels. Mechanical engineering students Stephan Olsen and Chris Brown worked on ways to drive an alternator to charge a battery via pedal power from a stationary bike and also by steam created by solar energy. Thanks to these and other students, my dream of transferring technology was taking shape.

So in July 1997 I found myself back in Africa, drawn by many attachments:

the desire to see friends, a fascination with the continent, wanting to see a dam I had designed (see related story) filled with water and being used by people, and, most important, exploring ways to involve more engineering students in this experience. The latter was my "justification" for going. Part of my ongoing, developing dream is to locate a couple of students for a few months at sites where they can use their skills to benefit people and in turn learn about their cultures.

Sunlight collected by this parabolic mirror turns water into steam that drives irrigation pumps. Fr. Otten's electrical engineering students in Seattle work on such solutions to needs in Africa.

One potential site is a Jesuit Refugee Service facility in Angola, where I helped install the solar power supply for lighting and computers last year. There will be additional solar projects for volunteers, and they could also help establish a water system (at present water is carried to the site over a distance of one kilometer), teach English or arithmetic, or lend a hand to any number of other projects.

A Jesuit parish in Kabwe, a small Zambian town, presents another opportunity. There are some old buildings in the back of the parish house that the pastor would like to use to teach skills such as blacksmithing and carpentry. He needs electricity for lighting and running power tools.

Another remote parish in Chisgombe is powered by a water-driven generator badly in need of repair. The electrical distribution system is in need of redesign.

Students who go will experience a culture that is in sharp contrast to the one they know in the United States. They will get some idea of how most of the people on the planet live. They will learn some of the beauty of African culture and will make friends different from any they have met before. Perhaps they will see the horror that war can do to a society and the effects

of colonization. They will be offered a new perspective on their privileges and responsibilities as members of a First World society. And they will find satisfaction and enjoyment in working with fine people.

This fall I am once again back at Seattle University teaching electrical engineering courses, encouraging international projects especially in the developing world, and trying to organize the African Project. In September I made my annual eight-day retreat; it was a great opportunity to look back over my 65 years and give thanks for the texture and richness that God has put into my life as a Jesuit, a priest, and a human being.

To Make a Lake

by Fr. Bert Otten, SJ

Commercial wheat farmers up-stream from Kasisi Agricultural Training Centre (KATC) in Zambia were using all the water from the Ngwerere River for irrigation and were turning the river into dust for a month at a crack, twice a year. You can imagine how this affected morale at an agricultural training center. After fruitless negotiations with the water

association, Br. Paul Desmarais, a Canadian Jesuit who is director of KATC, decided to build a dam. I taught myself surveying. We picked the best site for the project, and a retired British agricultural advisor, John Williams, taught me how to design earth dams. We started construction with tractor-drawn dam scoops provided by donations from MISEREOR and the American embassy. The Zambian National Service (ZNS) was enlisted to do a little over half of the work after we calculated that it would take us about two and a half years to complete it with just our resources. FACSI, a Jesuit source, and the Diocese of Stuttgart also donated funds.

There were many frustrations: one of the banks holding our funds failed, and our heavy equipment went on the fritz repeatedly. I had extended my sabbatical by a year for this project, but I finally had to leave. Once the rainy season started, Br. Desmarais, his crew, and the ZNS worked even on weekends until the 365-yard-wide dam and spillways were complete enough to handle the rest of the rainy season. If the rising water, which rose to only an inch or so from the top of the dam, had breached it, the whole thing would have been washed away.

The resulting lake is spectacular. It backs up about two and a half miles

from the dam and is 30 feet deep at its deepest. People now have an assured source of water during the entire year. They also have fish to eat --adding protein to their diet --and to sell in town.

Fr. Otten and crew survey the site for an earthen dam
that stabilized the water supply for wheat farmers in Zambia.

Author Fr. Bert Otten, SJ, had the opportunity to introduce his solar

cookers to women's groups in Tijuana this summer before returning to Seattle University to teach electrical engineering.

Page maintained by Richard VandeVelde, vande@math.luc.edu.
Updated: Wed., April 08 1998

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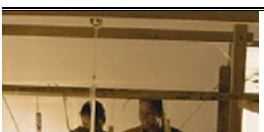

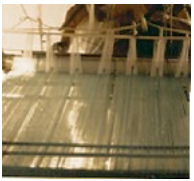

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Pedal Power Generator

Basic Idea:

While jumping or running our legs are generating 50-200 Watts of power. If this is converted to electricity and stored in a battery cai we use it in the night for lighting purposes?

For example:

A 11 Watt CFL bulb can light up a room. Radio, taperecorder, lou speaker use about 1-5 Watts. An LED light consumes less than 1 Watt. Thus a human being is capable of generating his/her own lighting needs!

How AID approached the problem:

We initiated a collaboration with the Industrial Design Centre, IIT-Mumbai through a student-project. By Jan 2000 the prototype of t

Your Support
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- India Bound ?

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Pedal Power generator generating 40 watts was ready. This excit activists such as Michael Mazgaonkar who connected us with Ronnie Sabawalla of Rashron Auto Ltd. To take a laboratory mod to the point of mass production we need people experienced in manufacturing. By June 2000, Ronnie Bhai made a new prototype that could generate 70 Watts. This was installed in Domkhedi village, which is in the tribal belt of Maharshtra where there is no electricity grid. When the Satyagraha against submergene due to SSP dam was launched in July 2000, thousands of people came from these regions and when they saw this Bijli Bike they pedalled Medha Patkar commented that this was the first CFL in the valley more than 50 years after independence! The brightly lit Satyagrah hut in the dark background of the hills was quite a sight even from distance. The feed-back of the village people on posture and pedalling speed helped make an improved batch of 7 new pedal powered generators.

By 2001-2002 the design has been perfected and the Pedal Powe Generator is available from Rashron Ltd through mail order. It cos about Rs 7500. AID is subsidizing about 50 % of the costs for

schools and NGOs working in villages without electricity. More tha 30 generators to groups in several states including Jharkhand, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat have been dispatched. To order contact aid@vsnl.com

Simultaneously we are collaborating with BSFC in Mozda village to set up a workshop so that alternate energy through pedal and win can be pursued there. This will help create livelihoods in the rural areas while providing electricity.

Why are Village People So Interested? The Economics...

We conducted an energy survey in Nimgavhan village, that neighbours Domkhedi. On an average a tribal household consume 3-5 litres kerosene a month for the kerosene lanterns or oil wicks. Rs 9 per litre this is about Rs 35 a month. In addition batteries for torchlights cost another Rs 30 or so a month. In the Nimghavan Jeevanshala (boarding school for 100 children) there were 9 kerosene lamps and average expense of Rs 270 a month. Anothe

Rs 150 for batteries.

All these kerosene lamps won't even generate half a unit (KWHr) worth of light in a month, and yet it costs a rural household Rs 65 month..... thus the rural people pay 50-100 times more per unit of light than the city people.

What inspired this work?

When we were travelling in the tribal villages in Andhra Pradesh ar in the Narmada valley we saw that little children were studying late in the night -- as late as 9-10 PM in Non-Formal Education centre's in AP and till midnight even in Jeevanshalas or boarding schools ru by NBA. Since the entire village was dark these children would sha one oil lamp between 5-10 kids and read in that light. Moreover th very people who were being displaced by the dams for the sake o hydropower were people whom the government decided to leave darkness -- that there were lights in rehabilitation sites mattered li as there was no land in these sites for farmers to have a livelihood so no one was willing to move.

Who should use Pedal Power?

Certainly village schools and NGOs will be driven by the need. In addition this is a very good educational device for the city schools because children should learn how easy it is to be self-reliant and how simple it is to start tackling the enrgy problem. People in citie should feel happy to try alternatives in solidarity with the poor, anc have a change in life-style.

What are the future directions and other projects?

In pedal power we want to try LED lights. More work is needed in the front of batteries. For example, circuits that switch off when battery power is low and prevent over-discharge need to be made and more easily available in rural areas. Every village has at least one government subsidized solar panel that is usually lying in dis-u or under-use. This has to be addressed.

Alternate energy has to also be connected with local livelihoods. Solar PV technology is high-tech. and not much use for villages or

even small cities in terms of generating livelihoods there. On the other hand things like pedalpower, windmills, biodiesel run engines can generate employment at the level of towns. Also electricity mu not be equated with energy and there can be number of initiatives that directly use the energy for water pumping etc.

Finally...In a nut shell...

15-20 minutes pedalling in the day allows you to light up a room fo 1 hour in the night. Want to get one?

Pedal Generator in Action...

A pedal power generator, aka **Bijli Bike** allows satyagrahis to power thi own lights.15 minutes of pedaling will run one 11 W compact fluorescen light (CFL) bulb for an hour.A product of Association for India's Development(AID)'s project in India.

Shown here is an 11 W compact fluorescent light (CFL), the first ever in the tribal villages in the submergence zone. 15 minutes of pedaling will run one bulb for an hour.

Rukmini kaki at domkhedi satyagraha with her flashlight off while Ashutosh pedals, generating light much more cheaply than using batteries or kerosene lamps.

An adivasi farmer fror turkheda (Guj) who al with 4 other families i considering buying the pedal generator.

For more info.

- On Pedal Power: aid@vsnl.com
- on Bio-Mass/Bio-Diesel: vriyer@bom8.vsnl.net.in

*Like the **charka is for our clothes** the **pedal powered generator is for energy**. It is a way to be self-reliant and bring livelihoods to the rural areas.*

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Association for India's Development. P.O Box 149, College Park, MD 20741, U.S.A
info@aidindia.org

http://www.aidindia.org/hq/projects/illus/pedal2.htm

MAJOR BUSINESS NEWS

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May 10, 2002

Dow Jones WebRepri Service

In Impoverished Niger, Radio Provides Missing Links in Chain of Development

By ROGER THUROW

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Staff Reporter of THE WALL STREET JOURNAL

AMATALTAL, Niger -- "Hello."

The word floated on the desert airwaves to the Tuareg herdsmen, as mysterious and alluring as a mirage. In their flowing blue robes and turbans, swords dangling at their sides, the men strained to hear more.

"You are listening to Radio Afalla," came next in their Tamachek language. "This is your radio station."

These first words over the Tuaregs' radios originated in a two-room mud-brick hut on the edge of this Sahara village. Outside, a red-and-white antenna jutted some 70 feet above the parched earth, the tallest object for miles in this flat desert expanse of sand and sparse, spindly scrub. Solar panels powered a car battery linked by wires to a compact console of two tape players, two compact-disc players and one microphone. Many of the radio receivers the Tuaregs cradled to their ears were hand-crank

models or secondhand transistorized relics from the 1960s.

This is a far cry from the digital technology that connects other parts of the world. But in a country of staggering poverty -- 80% adult illiteracy, 45-year life expectancy, and pockets where 40% of the children die before the age of five -- progress is coming not on the wings of 21st-century inventions but through a discovery from the 19th.

"With radio, we are getting to know the world," says Radio Afalla broadcaster Adam Habiboun outside the studio, which went on the air in March. Camels and donkeys meander past on their way to a nearby watering hole.

About 40 community stations have blossomed in the Niger desert after a recent rainfall of funding from an array of aid organizations. The local DJs are nomads and desert dwellers themselves. Music is only the background to the childbirth advice, vaccination updates, sanitation instruction, farming tips, candid talk on AIDS, and the occasional all-points-bulletin for lost camels.

"We have learned how we should wash utensils before cooking, clean the area where we eat and prepare food, cover the food with cloth to keep the flies away," says Essa Hassana, who is sitting with three other women in the village of Ingall, 100

miles farther north into the desert. Ingall's simple studio struggles to hold back the Sahara. Sand covers the floor, and lizards seeking shade scamper up the walls.

"As soon as a child gets an illness that can be spread, the radio puts out the information," says Zeinou Sami, another of the women. "Now we have fewer epidemics than before. Fewer children are dying."

Such progress has often eluded this harsh country, which is one of the world's poorest patches. The relics of many high-minded, high-tech development projects litter Niger like the dinosaur bones occasionally discovered beneath the shifting sands. Sophisticated irrigation systems that work well with First World maintenance turned into rusted pipes in Niger. The European cows that were supposed to improve milk production keeled over in the heat. Computers that launch villages elsewhere into cyberspace were grounded here, awaiting spare parts and support know-how -- not to mention electricity and telephone connections in a country with only 18,000 telephone lines for 11

million people.

Digging through these ruins, development experts from the United Nations, the World Bank and a host of aid organizations have discovered what their critics suspected for years: Rarely had anyone asked the villagers of Niger what they needed and what would work in their merciless environment. More rarely still did anyone put the locals in charge and leave the project in their hands.

"In the past, people weren't hearing each other," says Geoffrey Bergen, who taught English in Niger as a Peace Corps worker and now is the World Bank's country manager here. "We came to the point that we knew we had to listen better."

Radio "is the missing link in the development chain," says Steven Ursino, director of the United Nations Development Program, or UNDP, in Niger. With its manageable, cheap technology, it goes to places the Internet can't, beyond the reach of electricity and telephones. It demands the participation of the

villagers and can become the soul of a community. Above all, it stimulates communication in the local languages that is vital in attacking problems such as AIDS. "It gives the people a voice," Mr. Ursino says.

After Sept. 11, the stakes are higher to get things right and show progress in development. From the White House and the World Bank and the U.N. have come pledges to extend the war on terrorism to a war on global poverty and the instability it breeds.

Niger, where shortages of medical supplies sometimes mean hospital patients must bring their own material for sutures, figures it should be on the front line. "If they are serious about what they are saying, then they should support us," says Hadiza Hima, the secretary general of the Ministry of Education, which is battling the world's worst literacy rate. "Every five years we hear new commitments, but nothing is done."

According to the UNDP's Human Development Report, which ranks the well-being of the world's countries, Niger is one place

from the bottom, ahead of Sierra Leone, a fellow West African nation that has been mutilated by civil war. By some standards, Niger is worse off now than 20 years ago. Demand for its uranium has shrunk and two coups in the 1990s crippled government services. International development aid dropped to about $190 million last year from $270 million in 1990.

For the past two years, though, the country has been peaceful, with an elected government pledging to decentralize its operations and spread development aid around the country to quell discontent. This has prompted an increase in foreign aid and encouraged agencies such as the World Bank and the United Nations Children's Fund to intensify their consultations with the rural communities. And this, in turn, is allowing village radio to take hold in the sand.

Cautious Embrace

The Niger government, a new convert to rural development, has cautiously embraced the radio network. At last month's

inauguration of four stations, including the one in Amataltal, Aboubakar Souley, the secretary general of the Ministry of Transportation and Communication, told the villagers that the station is not to broadcast politics or religion. "For once you start with that," he says, "you divide the population and then you can't use the radio for development anymore." The stations are members of a self-regulatory body that promotes broadcasting ethics and adherence to the no-politics code.

This concern that the stations could become propaganda conduits reflects Niger's position at the confluence of poverty, religion and geopolitics. It shares vast borders with Libya and Algeria to the north and Nigeria to the south. Sharia, or Islamic law, has been implemented in parts of northern Nigeria, and the Niger government is trying to keep it from moving farther north.

Although more than 90% of Niger's population is Muslim, the government is secular and insists it won't brook any extremist movements. The country's leaders turned up at the U.S. Embassy after Sept. 11 to condemn the terrorist attacks in

America. But so did a letter from two Islamic organizations, warning Washington of a jihad should Osama bin Laden or Afghanistan be attacked. The government immediately dissolved both organizations.

"Poverty is connected to everything," says Amirou Garba Sidikou, secretary general of the Council of Traditional Chiefs, local leaders who hold considerable sway over village life. "We are a tolerant Muslim country. But people who are poor will do anything."

In Amataltal, Arahmat Koutchan leads the way into the Radio Afalla station, which is festooned with decals of two of its main donors: the U.S. Agency for International Development and U.S.-based Africare.

"This is our future, and I'm very optimistic," she says. She is the director of the station and proudly shows off the new mud-brick studio to a caravan of representatives from aid agencies and embassies who have come for the inauguration. "Education,

health, food, child care, news," she says, ticking off the subjects featured during the six-and-half hours of daily airtime.

Djilali Benamrane, a UNDP economist in Niger, hears this and thinks back to the origins of the first station three years ago. He was assessing a food shortage in the town of Bankilare when he heard a strange request from villagers. "I was talking with a group of women, asking them what help they needed, and they started laughing," he recalls. "They thought it would be impossible, but they said they were dreaming of the day they could have a radio station, not so they could be in touch with Paris or Niamey, Niger's capital, but to be in contact with the neighboring villages."

Months later, with UNDP funding and the simple technology provided by the African Center of Meteorological Applications for Development based in Niamey, their dream became the model for rural radio in Niger. Other groups have signed on to fund the stations, forming a broad coalition that includes various U.N. agencies and the World Bank, aid organizations such as

Africare and Helen Keller International, and foreign governments such as the U.S., France and Switzerland.

The stations cost about $15,000 each to equip and build. Fueled by solar power, they are cheap to operate and maintain. Each station has about a dozen workers -- broadcasters and technicians -- who are volunteers from the local communities. Once trained, they then train others. The goal of the development agencies is to have a network of 160 stations, each with a broadcast radius of about 20 miles, by the end of 2004.

On the Air

The Amataltal station was on the air after five months of work, with the community pitching in on construction and set-up. On a clear morning last month, the villagers gathered for the official inauguration. They came on camel and donkey and foot. The Tuareg men in their blue robes formed a reception line that looked like a flowing stream. The women, in colorful gowns, sat astride decorated donkeys or sang and played bongo drums. The

children gathered at their feet. The village chief, Akanamwa Hosseini, had ordered up a feast of roast lamb, noodles and camel cheese.

"This is the first time we have ever had radio that we can understand," Mr. Hosseini said. On the rare days when the national signal from Niamey, 600 miles to the south, would float their way, it came in languages foreign to the local residents, he said: "Now people around here are forming listening clubs, where they share a radio, to listen and discuss. We even get feedback."

Already, the chief said, people are asking for more overseas news shows, such as Voice of America, broadcast in the local language and picked up by the World Space satellite receiver that comes as part of the radio station. And, he said, people are already planning to set up businesses around the station, such as vegetable-drying ovens and millet grinders.

Throughout the country, activity is stirring beneath the red-and-

white antennas. In Dogondoutchi, Aichatou Garba sat in the sand holding a pan over a fire, a battered red plastic radio at her side. She said she was inspired to start a small business after listening to programs about what women in other villages were doing. She was making millet pancakes to sell in the market. "The radio says it is important to have high quality and good presentation," she noted.

In Ingall, a town of about 6,000 people, dozens of listening clubs have formed around the radios. Programs on AIDS and the health perils of early childbirth spark freewheeling discussions. And they unify the community on important days, as when a vaccination team comes to town. Before radio, vaccination schedules were unreliably passed on by word of mouth. "Now, we know exactly when they are coming, because the radio follows them from house to house. We can make sure we are present," says Ms. Hassana. A radio reporter even tapes this conversation with a beat-up recorder, for broadcast later in the day.

One of the first stations, the "voice of the youth" of Niamey, was built in a ramshackle neighborhood beyond the capital's Embassy Row. Radio Goudel has since become the hub of the network. Here, much of the programming on development issues provided by the aid organizations is translated into the nine main languages of the country and recorded on tape, as are talk shows. These tapes are then dispatched to the other stations when someone is heading in their direction.

At Radio Goudel, the digital divide between Niger and the developed world opens wide. In one room of the station, several computers are covered by plastic sheets, rendered useless by a lack of spare parts. In the next room, technicians from stations around the country learn how to repair the simple wind-up radios from the Freeplay Foundation of London, which is mainly funded by the Freeplay Energy Group, maker of the self-powered products. The radios have a mainspring that drives a small generator as it unwinds, and some also have a small solar panel.

The caravan of aid officials that visited Amataltal pulls into the

remote mountain oasis of El Meki and is greeted by an honor guard of Tuaregs on camels. There are no marked roads, or even any local cars. But there is now a radio station, and it is becoming the center of village life. Often, one of the broadcasters wanders into the primary school to record what is going on in the classrooms. Currently, only about one-third of the village children go to school; the rest are out tending goats or cattle, hauling water or foraging for food.

"Radio is the best promotion ever for school. The children sing and joke and explain to other children listening why they should also go to school," says the principal, Abdube Adamou. "I'm expecting many more students to sign up once we begin classes again in the fall."

In the dusty expanse between the school and the station, a Tuareg sits in the shade of a tree, a sword across his lap and an ear cocked to an old transistor radio.

What is he listening to?

"It's a health program," says Ekawel Ibrahim, who, at 43, is pushing the envelope on life expectancy here. "It's about precautions for keeping the drinking water clean."

Is he learning anything new?

"If I wasn't," he says, "I would turn it off."

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