Is solar energy "free"? There sure seems to be quite a lot of misunderstanding on this key question. It turns out that solar electrical energy is just as "free" as oil is. In either case, you just go get some (there’s pools of oil all over the place; they are just covered up with some rocks and dirt). Then, you’ll gather up and concentrate the energy, purify it, convert it to some useful form, and finally transport it to an accessible place.

Your only tiny little trick lies in spending less already existing energy over all of your finding, conversion, purification, and concentration than you will get back. If you get more back than you put in, you have a net primary energy source. If you input more old energy than you get back, you have a secondary energy sink.

For an overall net loss.

All of which leads us up to an oft ignored field known as engineering economics.

The term "money" can mean many different things to different people. Let us try this definition: Dollar: The personal use and control of all the deliverable energy in one gallon of gasoline. You vote for this definition every time you make any withdrawal from your nearby Texaco bank.

Using this definition, you could substitute "gallons of gasoline" for "dollars". Thus, if a solar array costs you $10,000, you can think of this as costing 10,000 gallons of gasoline. If interest is $1000 per year, this equals a thousand gallons of gasoline. And maintainance is something like nine gallons of gasoline per hour.

Gallons that are forever gone. And unavailable for any other use.

Your key question is whether the net total lifetime new solar energy generated will ever exceed all of the gasoline needed to build, finance, and maintain the site.

If an oil company spends less than a gallon of gas to deliver any new gallon of gas, we say they make a "profit". When they spend more, they have a "loss", and are simply doing the equivalent of destroying gasoline.

Overall, I’d guess something like a quarter of a gallon of older gas gets spent delivering one new gallon. By this point of view, virtually all solar electrical power so far is really an energy sink driven by the inefficient misuse of gasoline in disguise.

Arguably, a rather strong case can be made that most of nuclear power to date also is (and almost certainly will remain) a gross energy sink that is heavily subsidized by gasoline and other conventional fuels.

Now, it is just fine to spend energy on research and development. It’s also fine to be temporarily inefficient when a future net energy source gets perfected. Provided, of course, that the target source remains viable. It is also sometimes fine to spend more energy than you’ll get back for "Uh, compared to what?" needs.

But failing to recognize the hidden subsidies in any supposedly "free" energy "source" is sheer stupidity. So is failing to learn the fundamentals of engineering economics.

## A New DAA Phone Interface

The folks at Silicon Laboratories have just come up with a new chip set which makes DAA telephone data access arrangements a lot simpler, smaller, and cheaper. But first, let’s review exactly what phone interface is all about...

The typical telephone subscriber loop appears in figure one. These are the wires that reach from your nearby central office to your property line. Power is delivered from a -48 volt battery, through a pair of 200 ohm resistors. Green or tip is closer to ground. Red or ring is closer to -48.

Capacitors are chosen to couple two-way or full duplex audio onto the balanced lines. The balance reduces crosstalk in cables. Your audio can be analog voice, digital data, caller id tones, dialing touch tones, or other supervisory signals.

Ringing is done by superimposing very large low frequency intermittent sinewaves on top of the dc loop. A typical ring signal might be 50 volts
at 28 Hertz. These can range from 40 to 150 volts rms and from 20 to 40 volts. Capacitor coupling is usually used to isolate the ring signals.

When on hook, there’s around 48 volts on the line. Should any single phone get taken off hook, the voltage drops to around 8 volts. Measuring this voltage gives you a simple “the line is in use” detector.

What is the maximum power you can take off the phone lines? If you match the source impedance on a short distance line, something just over one watt. If you use the load the phone company wants you to on a longer line, then something closer to half of a watt or so. All your local phone equipment has to share this meager power, unless they somehow access internal batteries or ac power connections.


Just being compliant with the rules is not enough. You also have to go through a very costly and gruesome process involved here. As near as I can tell, a series of locked pulse frames get set up between their two chips. These apparently provide two-way data and voice comm as well as providing the on-hook power for the -B chip.

Extremely elaborate transmit and receive filtering is provided for. This approach also eliminates any need for relays, hybrids, or optocouplers.

Their chip set is controlled by an external micro of some sort. Which could be a digital signal processor or gate array inside the modem. But you can easily work up a PIC interface. As with any micro controlled chip, there will be a dozen or so internal registers that can be read or written to select various options or to input and output data. Full programming details appear on the data sheet.

Cost for the chip set is under $5 in quantity. Modem speeds up to 57.5 kilobaud are fully supported.

A demo board and ready-to-use reference design is also available. I have gathered a few additional DAA suppliers together for you as this month’s resource sidebar. Your essential trade journal here will be Compliance Engineering. Secrets of caller id are found in HACK43.PDF. Bargains on telephone line lockouts at www.tinaja.com/barg01.html. These can prevent “modem blasting” should any extension phone get inadvertently picked up.
Fig. 3 – NEW DAA FROM SILICON LABORATORIES uses a pair of integrated circuits and balanced coupling capacitors to eliminate the transformer, hybrid, and ring detector.

Bounceback and Friends

A lot of webizens sure do end up surprised whenever some capacitor seems to magically acquire a charge and terminal voltage after just sitting around for a while. These "magic" voltages are often attributed to free energy, extragalactic communication, or even petrovoltaics. Or whatever happens to be the Scam Du Jour of the pseudoscience crowd.

Uh, it turns out there’s usually no magic here at all. Chances are the apparent charge all gets created by inherent defects inside the capacitor which involve dielectric absorption. Sometimes called "soak". Basically, because of lateral charge migration, there can be a lot of little capacitors scattered around inside the dielectric of your big one. It sometimes takes these absorption caps an amazingly long time to charge and discharge.

Months, even.

The electric utilities call this effect bounceback. Any older large paper and oil capacitor might be charged to 30 kilovolts while in service. It might be thoroughly discharged and shorted out a dozen times. But let the cap sit for a while open circuited, and it may eventually end up with a deadly 3 kilovolts or so of highly unexpected terminal voltage.

Bounceback is sort of a second cousin to electrets and the buried charges in eeproms. It’s just not quite as permanent.

The bounceback effect is showable using a Leyden Jar in a Physics 101 lecture. But let us ask an electrical safety web site to summarize...

"All high grade capacitors, if left on an open circuit after discharge, will recover a considerable portion of the original charging energy. Highly dangerous voltages can build up in open-circuited capacitors over a period of many months after they have last been discharged. This is particularly true where inexpensive paper dielectrics have been used."

There is a very simple test to find out which utility linemen remained awake during Bounceback Lecture #01-A on day one, session one of lineman school: They are the ones who are still alive.

This bounceback effect is most noticeable among the larger and older
capacitors. The better new capacitors will carefully specify their dielectric absorption as a percentage. Thus 50 millivolts of bounceback might be expected from some previous 5 volt charge with a one percent dielectric absorption. Even small amounts of bounceback get critical in dual slope integrators and other places where you are trying to accurately measure a current over time.

While old paper caps might have ten percent dielectric absorption, the finest of premium teflon caps might offer 0.01 percent bounceback. Half a percent is typical for better mylar caps. Electrolytics in particular are a bizarre witches’ brew of chaotic electrochemistry. They should never be used anywhere near any critical electrochemistry. They should always have to rigorously eliminate bounceback, because this common and expected effect might end up much stronger than what you think you are measuring.

Another PIC Power Meter

Just received a review copy of the Brand Electronics model 4-1850 power meter. This one is in a five inch square by two inch high case. Power consumption, total energy used, runtime hours, plus monthly and average operating costs all get displayed. The costs assume a fixed ten cents per kilowatt hour.

There is a single grounded outlet at the rear. You plug in the appliance whose energy consumption is to get measured. List price is $149.

Since many hundreds of samples are taken per half cycle, the ability to handle unusual waveforms and high crest factors seems inherent.

Home energy management starts off with a careful measurement of your appliance running costs.

Power measurement and related home energy monitoring topics often show up in Home Power magazine. The website is www.homepower.com Circuit details of reference design for a PIC based wattmeter are available from Microchip Technology via their www.microchip.com website. Lots more on PIC’s in general are found at www.tinaja.com/picup01.html

New Tech Lit

From Seiko Instruments, a new CD ROM on all of their components and integrated circuits. From Maxim a thick new Product Selector Guide and CD. From Omega Engineering a useful free wall chart about infrared measurement fundamentals. From Quik Voice, a handy booklet full of solid state answering machine and ad messaging circuits.

Interesting info on photopolymer films is available by way of Ulano. Tiny keychain sized electronic cases are gotten from Polycase. Unusual micro cut woods are stocked in depth by Midwest Products. From Hilti, a line of laser instruments to measure, plumb, and level. All at once.

A scheme for directly converting solar energy into hydrogen in a single cell is described in Science for April 17, 1998 on pages 382 and 425-427. While the claimed efficiency is an outstanding 12.5%, their economics otherwise are likely to remain poor. Materials similar to those used in LED’s are involved.

Robot Science & Technology is a new robotics magazine. Published by Mike Greene. An Amateur Television Quarterly continues to be a well done labor-of-love newsletter.

Our featured trade journals include PC-AI on computer based artificial intelligence. Plus a mention of the good old Hewlett-Packard Journal.

Free chip samples for this month are the CLC5523 250 Mhz low power variable gain amplifier from National Semiconductor Plus a new S-8430AF combination step-up and step-down regulator from Seiko Instruments.

Lots of great buys on Tek scopes
and ethernet cards could be found at www.tinaja.com/barg01.html.

Once you get beyond its obviously redundant title, Windows Annoyances is a really great book. Lots of useful tips here on speeding things up and reducing frustration. David Karp is the author. $29.95

Irvin Glassman’s Combustion is apparently the definitive university text on everything involving flames.

In particular, this fine text clearly shows exactly where, when, and for how long any monoatomic gases are permitted when burning hydrogen.

I’ve got access to these titles and a full power search for just about any other book (technical or otherwise) at www.tinaja.com/amlink01.html.

To receive instant and thorough answers to any technical subject, do check out my new InfoPack service at www.tinaja.com/info01.html. And the insider secrets of active filters are found in my Active Filter Cookbook, per my nearby Synergetics ad.

The latest additions to my Guru’s Lair website at www.tinaja.com now include a new tutorial on cubic spline curve fitting, several of the latest newly discovered and delta-friendly magic sinewave sequences, plus a tutorial about offshore electronics resources. A new site search has also been added.

A reminder that most of the text mentioned items appear in our Names and Numbers and DAA Resources sidebars. Always check here before calling our free US technical helpline shown in the nearby box.

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