

Got Sun? **Go Solar**

EXPANDED 2ND EDITION

Harness Nature's Free Energy
to Heat and Power Your Grid-Tied Home

Rex A. Ewing *and* Doug Pratt

PIXYJACK PRESS  INC.

Introduction

Have you ever gotten so tired of waiting for someone to do something for you that you finally just did it yourself? That's how most of us learn to fix our bicycles when we're kids: we get fed-up waiting for some disinterested adult—who will probably want an extortionary favor in return—to grudgingly agree to adjust the brakes or patch a flat tire. Exasperated, you march off to the garage, fish around for a few tools, and get to work on the problem. By the time the repair is done and you're glowing with a self-satisfied sense of accomplishment, you realize it really wasn't all that difficult.

Sound familiar? Then this expanded 2nd edition is for you. The air these days is buzzing with talk of our expanding national commitment to renewable energy, and we applaud the government's efforts that set a more sustainable course for our country's energy future. But the only way to personally be an active part of this green energy is to make a resolution to wean your house or condo (or, yes, even your apartment) from the fossil-fuel cow. It's not as hard as you may

think: with a bit of planning and a few components, you can convert your little corner of the world into an environmentally responsible haven you can be duly proud of.

Today's photovoltaic (solar-electric) panels are cheaper, more efficient and versatile than they've ever been, and when combined with modern power inverters they will generate electricity that is "clean" enough to satisfy the persnickety needs of the most delicate electronics. Whether you want a large array to run an entire house or one PV panel for your apartment, solar electricity can be configured to fit your needs.

Got wind? The noisy, awkward, breakdown-prone wind turbines of the past have been replaced with quiet, highly efficient marvels of engineering that can produce useful amounts of power in a gentle breeze. Many of these new-generation wind turbines can be directly tied into the power grid without the need of batteries or charge controllers.

This is all really cool stuff that wasn't available a few years ago, and it's just waiting to be installed on or near your home.

Do you like the idea of legally spinning your electric meter backwards, and doing it with a simple, non-polluting, silent power source that will outlive your children? That's what solar energy can deliver right now, and this book will explain your options. Solar-electric and wind systems deliver their energy directly to your household, with any surplus pushing out through your meter into the grid. This is called utility intertie, or simply grid-tie, and it's legal in every state.

But solar- and wind-electric systems are just the beginning. There is also solar hot water to consider. It is, after all, an idea that's been in use since Roman times. And if you watch with dismay as the rising price of natural gas or electricity turn your morning shower into an increasingly expensive proposition, you may want to consider a solar hot water system for your domestic hot water needs. There's a system for practically every climate and budget, and unlike the showy, clunky installations of the Carter era, recent innovations in heat-collection technology combine efficiency with class and discreetness. Best of all, state and federal incentives for solar hot water systems are also there for the taking.

But not all renewable energy comes directly from the sky. Geothermal energy is perhaps the most efficient and least under-

stood form of free and inexhaustible energy. Modern ground-source heat-pump systems are designed to extract the heat from the ground beneath your feet so quietly and efficiently you'll feel like you're pilfering heat on the sly. It's the perfect hedge against rising heating-fuel prices.

So what are you waiting for? Whether you're a trained electrician or plumber qualified to do the work yourself, or just a homeowner who believes that waiting until tomorrow to make the world a better place is not an option, you can use the information in this book to help you decide which system or systems will work best for you. We'll even give you tips on making the most of passive-solar home design and also how to conserve energy in your home to achieve the greatest impact from nature's free and renewable energy sources. By the time you get around to finding an installer, you'll be on intimate terms with your future system.

If you still need a little push, the federal government and most states offer financial incentives for those willing to invest in solar, wind and geothermal energy, including tax credits and substantial rebates. And should you need financial assistance to get the process kick-started, we'll tell you how to go down that road, too.

Let's face it: you are all out of excuses.

Renewable energy is a proven technology that is affordable and adaptable to almost any situation, and the financial incentives are about as sweet as they can be. Whether you decide to travel down the path to renewable energy

on an off-the-shelf Schwinn or a custom-built Madone SSL by Trek, it's going to be your bicycle, so make the best of it. The wait is finally over. ❖

The First Modern Solar Cell

It wasn't exactly serendipity, which is, as they say, looking for a needle in a haystack and finding instead the farmer's daughter. No; back in 1952, Daryl Chapin from Bell Labs was definitely looking for the farmer's daughter from the get-go. He just didn't find her in a haystack.

Here's how it happened: Researchers at Bell labs, headed by Chapin, were trying to find a way to operate Bell telephones in remote places, of which there was no dearth back then. Dry cell batteries were short-lived, especially in hot, humid climes, so Chapin was searching for a more satisfactory source of power. Wind was considered, along with thermo-electric power and even steam engines. Chapin, being a solar enthusiast (there was a great deal of interest in passive solar after World War II, due to a worldwide fuel shortage), sug-

gested that the idea of photovoltaics be explored.

At that time, the only PV (solar) cells in existence were made of selenium. Selenium cells, however, could only produce about 5 watts per square meter; a mere 0.5% conversion efficiency. Chapin wanted 6.0%—a twelve-fold increase in efficiency.

As the gods of research would have it play out, two of Chapin's colleagues, Gerald Pearson and Calvin Fuller, were working in a nearby lab with crystalline silicon in hopes of building a solid-state rectifier, a device that transforms AC to DC. But pure silicon is a not a very good conductor of electricity. Fuller, however, managed to improve its conductivity appreciably by introducing gallium into the crystal matrix. Then Pearson took it a step further; he gave the gallium-rich silicon a bath in hot lithium.



Crystalline silicon solar cell.

For whatever reason—scientists do so love to play—Pearson shone a light on his crystal and discovered that the light energy induced an electric current. (He certainly must have shouted something like “Eureka!” at that point, though his exact words are lost to history.) Pearson rushed to Chapin’s office to announce the good news.

Though the first, crude silicon solar cell was not capable of the 6% efficiency Chapin was aiming for, it was far better than anything he’d yet found. Chapin went to work to improve it. The big breakthrough came when Fuller vaporized phosphorus onto the surface of a nascent solar cell. This brought the p-n

junction (of which you will read more, shortly) near the surface and, perhaps more importantly, allowed for the deposition of conducting channels to carry the light-induced current away from the cell and into an electrical circuit.

By 1954, Chapin, Pearson and Fuller had produced a 6%-efficient solar cell and announced it to the world. Much of this book follows from their discoveries...

SOURCES: *Solar Today* (Jan/Feb 2004) “Good as Gold: The Silicon Solar Cell Turns 50” by John Perlin, Lawrence Kazmerski, Ph.D., and Susan Moon; and www.eere.energy.gov/solar/solar_timeline.html.



PV panels power the space station Skylab (above) and an emergency radio tower in remote mountains (right). PHOTOS: NASA; SHELL SOLAR

In the late 1950s, solar cells were first used in space, and they quickly became the most widely accepted energy source for space applications. In 1964 NASA launched the first Nimbus spacecraft – a satellite powered by a 470-watt PV array. Since then, numerous craft have been launched, including Skylab and the Mars Rover. Solar cells are used today to provide power for remote telecommunications, signals and sensors, navigation aids, water pumping, highway call boxes, off-grid lighting, calculators,



watches, portable electronics, medical clinics, cathodic protection to prevent iron corrosion, security lighting, billboards, and emergency highway signage... not to mention our homes and offices.