

Dan Redmond lives in a 1925 bungalow home with his wife Margaret and two boys, Alec, 6, and Aidan, 3, in Arlington, Virginia. For the past few years, he has had one mission: to change the way his household uses and produces energy. He writes here about how they did it—and what they learned.



LIVING quietly

Story & photos by Dan Redmond

It was about two years ago when my son, Alec, and I opened a solar power experiment kit that I bought for \$10 from a local hobby shop. Since he loves his International Space Station replica, complete with blue solar-electric “arrays,” I figured his curious mind might like to see solar power up close. We found a sunny spot in the backyard and laid out all the pieces: a small photovoltaic module, wiring, and a tiny DC motor with plastic fan blades. After a few seconds in the sun, the tiny fan started to whirl. “This,” I explained, “is how the International Space Station generates its electricity.” Alec was in awe, looking up at the sun and then down at the fan. All it took was one look at my son’s face to get me serious about solar energy.

In the months that followed our experiment, I began to research “alternative” energy projects in the United States. A quick browse at our local bookstore turned up *Home Power* magazine, which I consumed in one sitting. Then came hours in front of the computer, perusing various Web sites. I came across one site—Renewable Energy Access—that completely changed my outlook on energy. It suggested that energy use and production could be “quiet”—without pollution, noise, smoke, war, or waste. *Quiet* energy: It almost sounded too good to be true.

Although I had my doubts, I also realized that the world had shifted from burning wood to coal and oil, all in the last 100 years. Why not renewable energy in my lifetime? The more I learned, the more I embraced the idea of quiet energy—and the more I started to believe in its feasibility for our country. Besides the much-talked-about environmental and political advantages, I liked the fact that the growing RE industry could bring new jobs to the United States, especially to

Dan and Margaret’s 83-year-old bungalow got a high-tech energy upgrade with a 12-module rooftop PV system.



Alec shows off the small PV module that spurred his family's switch to solar electricity.

our hurting manufacturing sector. Parts of the country that have lost jobs to outsourcing and foreign competition could again flourish with production facilities for renewable energy equipment.

I was surprised to learn that renewable energy programs are working more successfully in other countries. Germany and Japan, for example, are prioritizing solar economies. Because they have limited or no domestic sources of coal and oil, and must depend heavily on foreign nations for fossil fuels, their governments have supported aggressive incentive programs that have fostered new business and development in solar and wind energy.

Following the Circuit

Once I understood the feasibility of using renewable energy and realized that it was more than a large-scale experiment, I became a true believer in the power of the sun. My family and I attended a number of RE festivals and events, including the Washington, D.C., Tour of Solar Homes & Buildings in 2005 and 2006. We visited more than a dozen RE-powered homes on those tours, where I marveled at how homeowners were using new approaches to satisfy their everyday energy needs.

Among my favorite events in D.C. was the 2005 Solar Decathlon (see "High Design, High Performance" in *HP123*)—a competition in which custom-designed solar homes are erected on the National Mall and judged on their energy performance. Even during a rainy, gloomy week in October, the project homes powered a gamut of appliances,

heating and cooling systems, and even electric cars—with only the power of the sun.

Seeing solar in action convinced Margaret and me to go for it. Using the online directory, www.findsolar.com, I reviewed the qualifications of installers in my area. Then, at the 2006 Washington, D.C., Green Festival, I made a point of visiting the booths for the area's largest solar energy companies—all based in Maryland, where incentives are available.

Making a Connection

Going into the project, we knew that our home's orientation, which offered no south-facing roof space, wasn't ideal. The east-facing rear roof is shaded by tall, dense oak trees. We considered placing a pole-mounted array in the backyard, but didn't want to lose any space for the kids to play or for our garden. Besides, I wanted our PV system to be visible to the community. That left our west-facing front roof, which had an unshaded solar window—from 10 a.m. to 5 p.m.

We chose our solar-electric installers differently than some might, selecting the components we wanted first and then finding a dealer who could source and install them. Knowing that our system would need to be installed on the street-facing side of our home, aesthetics were important to me. I found modules made by SunPower that are completely black, including the frames and mounting system. As it happened, these modules were also the most efficient on the market at

Aidan points out the inverter's remote system monitor mounted on the living room wall.



"It was more important for me to spend our money on modules that generate electricity rather than on batteries to store it."

Making Cents of the Payback

With all the what-ifs of future energy prices, calculating the “payback” of a solar-electric system tends to be a rather convoluted task. Here in Virginia, where coal is abundant and produces most of the electricity, we pay below what most other states pay for electricity, about 9.4 cents per KWH. This “cheap” electricity adds years to the traditional PV payback calculation. However, once the idea of coal-to-oil liquefaction gains momentum and if coal is used for fueling vehicles, the cost of coal-based electricity will inevitably go up. That potential increase could shave years off our payback, but only time will tell.

Our 1,400-square-foot house doubles as an office for my wife Margaret and me; she telecommutes as a consultant for IBM and I work as an architectural photographer. Our office is equipped with a laptop and desktop computer, scanners, a laser printer, and backup hard drives. The combined electrical loads of our computer gear contribute to our having a slightly higher-than-average monthly usage compared to other all-electric households. Prior to our conservation efforts and PV installation, our average monthly use was 1,500 KWH.

After we implemented conservation measures and replaced our old appliances with more efficient Energy Star models, our bill averaged \$100 for roughly 900 KWH per month. (See “Our Energy Reduction Plan” on page 54.) Once we added the PV system, our electrical bills dropped even further—about 40%. If we wanted to swelter in Virginia’s summer humidity and not run our air-

conditioning system, our PV system would come close to meeting our annual electricity needs. Last year, from May to December, our electrical bill averaged \$42 per month, with a high of \$68 in August and a low of \$20 in May.

After the \$2,000 federal tax credit, we paid \$25,700 for our system, using a taxable savings fund that had big swings in interest payouts. Long warranty periods—10 years on the inverter and 25 years on the modules—take the fear out of the initial investment. Unfortunately, Virginia has been slow to adopt incentives and tax credits. Our system is exempt from state sales and property taxes, but that’s about all the state has to offer. If we lived a few miles to the north in D.C., we could have received reimbursement for up to 50% of the system’s cost through grants from the D.C. Reliable Energy Trust Fund. A few miles farther north, in Maryland, grants cover up to 20% of a system’s cost with a maximum rebate of \$3,000 for residential PV systems.

Despite the absence of incentives in Virginia, we have no regrets about our investment. For the next 20 to 30 years, our roof-mounted system will produce a large portion of the electricity we need. Though we’re not making a huge return on our investment (about 4% untaxed), we see our system as a safe place to park our cash. The rate of return is roughly equivalent to a conservative bond fund. And, so far, the sun always rises, making the system a stable and reliable investment every day.

the time, reducing the area needed for the installation on our small roof. SunPower directed me to their local authorized dealer, Standard Solar Inc. of Gaithersburg, Maryland.

I toyed with the idea of doing the installation myself, but I decided to leave the technical work to the pros. Though it cost a little bit more, hiring professional installers is one more way that people can help the industry prosper. Once we gave them the green light last March, it took four weeks to receive the components and then three days to install the

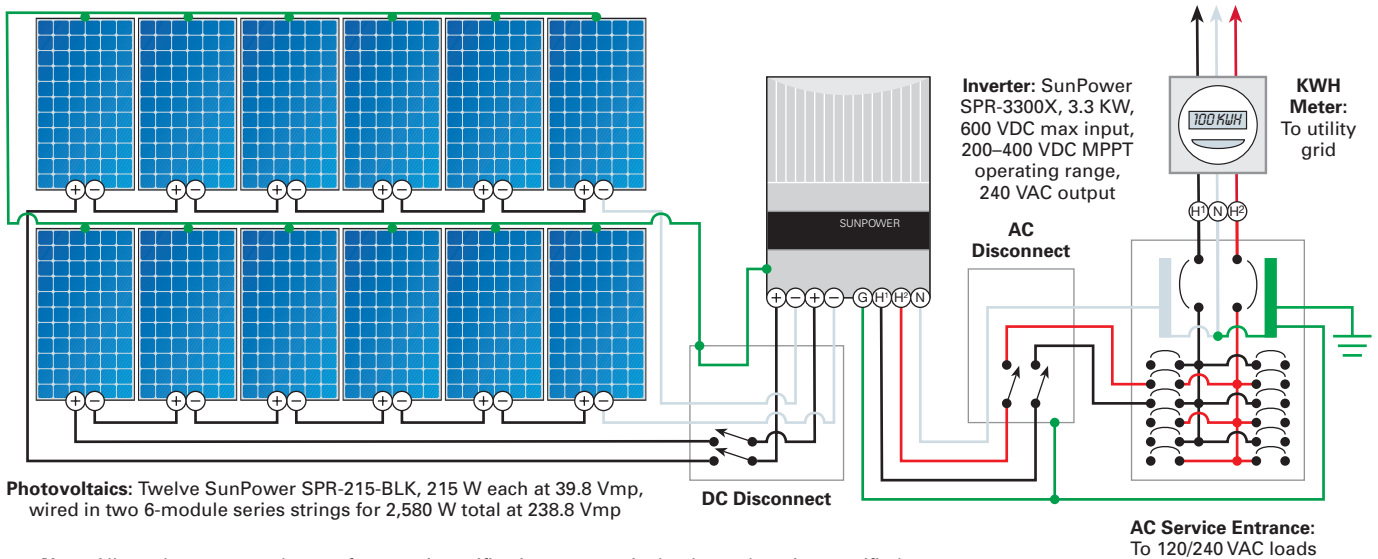
system at the house. By the end of April, the system was operational.

The finished product: A 2.6 KW grid-tied solar-electric system with twelve 215 W SunPower modules on the roof and a SunPower 3.3 KW batteryless inverter in the basement. We rarely lose power from the grid, so backup electricity was not a priority. It was more important for me to spend our money on modules that *generate* electricity rather than on batteries to store it.



This grid-tied PV system allows Dan and Margaret to enjoy lower electric bills while reducing their consumption of fossil fuels.

Redmond On-Grid PV System



PV pros Matt Griffiths and Kevin Higgins of Standard Solar secure modules to the rooftop mounting rails.

Running the Numbers

One of the system's coolest features is a remote monitor in our living room that enables us to view the PV system's performance. The monitor tells us how many kilowatts are being produced at that moment, as well as to-date total KWH production (1,715 KWH), financial savings (\$240 as of January), and carbon offset in pounds (2,100 pounds).

Because we positioned the modules on the west-facing front roof, the system works predominantly in the afternoon. Had we been able to face the modules south, we could have gained at least 10% in system output. Even still, the system has exceeded our expectations. As of early January, the system had generated more than 1,700 KWH of electricity since its installation in April 2007. The system was most productive
(continued on page 55)



Inset: The SunPower inverter is located in the basement, where it is out of the way yet readily accessible.

"Besides producing pollution-free electricity on site, the system is virtually maintenance free."

Our Energy Reduction Plan

Years before we got serious about our mission to live with solar electricity, my wife and I decided that we needed to do our part to save energy and reduce our utility bills. Our energy reduction plan evolved over several years. On paper, it may look like we have been very organized in this process. But, in reality, we made changes as we went along, adapting our lifestyle as we learned about new ways to efficiently use energy in our home. Here are a few of the baby steps that led to our final leap into solar electricity.

Step One. Long before the buzz about compact fluorescent (CF) lightbulbs, we swapped all our standard incandescent bulbs with high-efficiency CFs—which use about 75% less energy and last up to four times longer. Back then, there wasn't much in the way of selection, and prices were on the high side. Today, a four-pack of 13 W bulbs (equivalent to 60 W incandescents) costs about \$10, and bulbs in every size and shape accommodate a variety of fixtures and uses. Improved phosphor formulations have virtually eliminated the harsh fluorescent glare that once gave CFs a bad reputation.

Step Two. Since many of our appliances were nearing the end of their life expectancy, the timing was right to start replacing them with energy-efficient models. To spread out the cost over time, we replaced one major appliance per year with Energy Star-rated models. First came the dishwasher, second a refrigerator, and then, a horizontal-axis energy- and water-saving clothes washer. With two adventurous boys, we do lots of laundry. The new washer alone has reduced our water consumption by 8,000 gallons per year. Whenever the weather cooperates, we dry laundry on a Breezecatcher rotating clothesline.

Step Three. A story in *Home Power* introduced me to UltraTouch, a recycled denim insulation. At 5.5 inches thick, it has an R-19 insulation value. I loved the idea of using a nontoxic material that required no gloves or masks. For only \$300, I insulated two-thirds of our bungalow's main subfloor area. The material stays in place between the floor joists without staples or nails. New windows are coming soon, but for now, the insulation makes a huge difference.



Aidan patiently waits for another delicious treat baked in the family's solar oven.



The Redmonds replaced their second car with more sustainable transportation—an electric bicycle that's charged by their PV system.

Step Four. At a home-improvement store, I spotted a stack of 10 W PV modules that are used to power vent fans and wondered what else I could use them for. I bought three, and paired them with a single, deep-cycle marine battery and an 800 W inverter. We power all sorts of devices by plugging into the inverter's outlets. Small power tools, lamps, stereos, and even an electric vehicle—well, my boys' battery-operated Power Wheels kiddie car.

Step Five. Given our success with my sons' Power Wheels, we decided to use solar power for bigger wheels. We replaced our second car with an electric bicycle for local commuting and errands. An attached trailer enables me to take the boys to school and leaves room for groceries on the return trip home.

Step Six. After we learned that solar cooking is a relatively simple way to reduce everyday energy needs, we purchased a solar oven and started experimenting. We started with simple things, like cornbread and brownies. Soon, we graduated to chicken, potatoes, rice dishes, and casseroles. All year long, we see the savings in our gas bill. In the summer, outside cooking in a solar oven helps keep the house cooler. The best part: Aidan, my youngest son, now accepts renewable energy as a way of life. One day, when I declined his request to make brownies, he said emphatically, "But daddy, the sun is shining!"

Sources:

Bonded Logic Inc. • www.bondedlogic.com • Recycled denim insulation

Breezecatcher clothes dryers • www.breezecatcher.com • Rotating clothesline

Powabyke Ltd. • www.powabyke.com • Electric bike

Solar Ovens International Inc. • www.sunoven.com • Solar oven

“Just as you don’t have to know how a car works to drive one, you don’t have to be an electrical engineer to use solar electricity in your home.”

last spring, producing 10 KWH on sunny days. However, the dark days of winter take their toll on performance, when we get only about 3 KWH per day.

Any excess electricity that our system produces and we don’t use is sent back to the grid. Our KWH meter records this savings much like a deposit into the bank. When the sun is not shining, our household draws electricity from the grid—similar to withdrawing some savings from the bank. At the end of the month, the difference is calculated between the electricity we generate and the total electricity we actually use. That amount makes up our electrical bill. Any net excess is credited to our next month’s bill.

Living with Solar

In retrospect, I didn’t need to do as much research as I did. For me, learning was part of the process. Knowing what I know now, I am confident that I could have simply picked up the phone, written a check, and had a great system installed—because just as you don’t have to know how a car works to drive one, you don’t have to be an electrical engineer to use solar electricity in your home.

Besides producing pollution-free electricity on site, the system is virtually maintenance free. During pollen season and occasional dusty periods from nearby construction, I used a garden hose to rinse off the modules—since modules are most efficient when they’re clean. Otherwise, system operation is effortless. It starts generating electricity automatically as soon as sunlight hits the PV array and goes off-line at dusk. It’s that easy. And that quiet.

Access

Dan Redmond (redmondDK@mac.com; www.danredmond.com) grew up near the coal mines of West Virginia and understands firsthand the effects of the United States’ “cheap” electricity. Eventually, he hopes to add a solar hot water system to the house and replace the family car with a plug-in electric vehicle.

Standard Solar Inc. • 888-474-3843 • www.standardsolar.com • Installer

PV System Components:

SunPower • www.sunpowercorp.com • PV modules & inverter



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