ALTERNATIVE ENERGY SYSTEMS

PART III

Adding wind turbines to complement their motorhome's solar power system helped this couple to achieve their goal of living hookup-free.

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The following article concludes a three-part series about alternative energy systems. Part II (December 1997, page 60) focused on solar panel structure and performance. Part I (November 1997, page 98) discussed the authors' quest for energy independence and their early experiences with solar power.

We spent the winter of 1994-95 trying out our latest solar panel configuration at public camping sites in Arizona and California. We had just upgraded our solar power to 60 amps and were hoping this would nudge us closer to our goal of energy independence, to achieve our dream of a lifestyle free of electrical hookups.

While camped at the Imperial Dam Long Term Visitor Area (LTVA) on the California-Arizona border, we noticed that several motorhomes were using large homemade wind generators. They had attached propeller blades to an automotive-type alternator or generator mounted on freestanding poles adjacent to their coaches. They had then run a wire down the pole to connect the alternator or generator to a deep-cycle storage battery.

Then, while in Quartzsite, Arizona, we saw a commercially made wind turbine called the AIR Wind Module, manufactured by Southwest Wind Power. Because a wind generator has the potential to create power at night and on cloudy days, we realized it could be a valuable complement to solar charging.

The AIR Wind Module. The wind generator idea looked promising, so we called Southwest Wind Power and subsequently visited the company's plant in Flagstaff, Arizona. David Calley, the founder and owner, is a remarkable young man who built his first wind generator at age 12. Refreshingly idealistic, he hopes to help make the world a better place by manufacturing a product that creates power without pollution.

According to Southwest Wind Power literature, almost every part of the AIR Wind Module turbine has been developed from "the ground up" using 3-D computer models. The AIR Wind Module is very powerful for its size and weight. It uses the first and only permanent magnet alternator that matches the cubic power of the wind. In addition, it is the first and only wind turbine to use rotor blades made of injection-molded carbon-composite materials that meet the strength-to-weight ratio requirement of this computer-assisted design.

As wind speed nears 50 mph, the rotor reaches 2,250 rpm. At this rpm, aerodynamic forces twist the rotor blades, causing the rotor to stall. This is a passive function that protects the rotor. There is also a dynamic braking circuit that actively slows and stalls the rotor if the turbine is disconnected from the batteries. This feature prevents overspeeding of the rotor and possible component damage, which is common to other wind generators if they are not used with a diversion load when disconnected from the batteries. The dynamic brake, which can be activated with a switch, can also be used to intentionally disable the turbine. The turbine should always be disabled before one attaches or detaches the blades. The electronic circuit allows the turbine to self-regulate or use solar panel regulators.

Photos by authors

This turbine, set on a 5-foot pole, is one of two AIR Wind Modules situated on top of the authors' coach.

The AIR Wind Module is rated at 300 watts and can produce nearly 30 amps of 12 volts DC with a 30-mph wind. Other specifications and performance curves are shown in Figure 1. For a detailed look at the impact of the wind turbine on our power output, see Table 1.

The AIR Wind Module weighs only 13 pounds and requires a sphere of operation of 48 inches, making it suitable for RV applications. Since the wind turbines are predominantly used for remote homes or marine applications, Southwest Wind Power usually is not involved with the installation. However, Mr. Calley was as curious as we were about the turbine's performance on an RV, so he assigned one of his best engineers to create mounting hardware for our coach.

Installation. Collectively, we decided to install two AIR Wind Modules to test the feasibility of multiple installations on a single coach. One module was mounted on a 9-foot pole and the other on a 5-

continued

Support brackets and mounting poles help to keep the turbines stable.

foot pole, 8 feet apart on opposite sides of the coach. These dimensions were intended to minimize disruption of the airflow between the turbines.

For ease of welding, 2-inch black steel pipe was selected for the fabrication. L-shaped mounts with 24-inch legs lay with one leg along the edge of the roof and the other leg toward the middle of the coach. These support brackets were mounted onto the coach frame and roof rails in order to withstand the weight and stress. Screws were inserted through rubber bushings to help with sound abatement.

The mounting poles are located at the leg junction with a permanent brace attached to the shaft of the pole and hinged to the cross brace (see accompanying photo). When erect, a second brace pivots from the shaft of the pole and attaches to the side rail mount for added support. Because of the curved roof on our coach, the bracket angles had to reflect the curve in order for the poles to stow along the edge of the roof and still stand perpendicular to the ground when erect. For storage, the rotor blade assembly is removed so the body of the AIR Wind Module can lie flat against the roof.

The rotor blade assembly was reach able on the 5-foot pole, so that the elevation and storage procedure was *easily* managed by one person on the roof. The taller turbine was more difficult to man age. Not only was it heavy, but the rotor blades had to be attached or removed with the pole only partially elevated. This was a two-person job. We subsequently installed a used satellite dish actuator to lift and hold the 9-foot unit at any level of elevation. Now one person can raise or stow both turbines in less than 15 minutes.

We want to thank our friend, Carl Fiorletta, F107716, for designing and fabricating the hardware to attach the mounting pole to the actuator.

Mounting matters. This installation has performed in wind speeds in excess of 50 mph without any compromise to the mounting assembly.

A variety of mounting methods may exist, but whatever the configuration, the mount should be capable of withstanding 150 pounds of load in the horizontal direction. Another recommendation is the use of 1.5-inch schedule 40 steel or aluminum pipe. If the manufacturer's mounting specifications are not met, the turbine may have to be disabled during high winds using the dynamic brake previously described.

This would render the turbine nearly useless, because the power curve indicates that output becomes significant at wind speeds greater than 25 mph. If not disabled, a wind

Daily Charging Output, January 1997

Date	Amp Hours/Day	Maximum wind speed
1	0	10
2	0	9
3	40	33
4	82	30
5	9	24
6	107	32
7	313	55
8	40	25
9-13	0	Not in service
14	50	47
15	7	16
16	32	21
17	98	26
18	84	24
19	56	22
20	4	15
21	31	21
22	2	21
23	11	22
24	16	25
25	0	12
26	0	16
27	29	38
28	7	38
29	14	18
30	135	35
31	94	35

TABLE 1. Our instruments can measure only the maximum wind speed in a given period. If the wind is gusty rather than steady, a high speed may be recorded, but we do not have the capability of measuring the duration of wind speed. Note that the highest production days did not necessarily have the highest wind speed. Also, many days were windy in the morning and then relatively calm in the afternoon and evening. The days with the highest production occurred when we experienced sustained winds over a 24-hour period.

turbine on a substandard mount could be ripped from the coach and cause damage not only to the coach roof and turbine, but to anything in its path as well.

As anyone who has spent time in a motorhome knows, the wind can rock a coach. We did not note any increase in this movement when the turbines were operational.

The turbines are not silent. They produce an associated whine that we and others actually found soothing. We had no trouble sleeping with them in operation, but some people may be more sensitive to noise.
The average sound level inside the coach was in the range of 60 to 65 decibels. The sound levels outside were comparable, although the sound of the wind measured higher than the sound of the turbines. The manual for our sound meter lists background music as 60 decibels and conversation *as* 65 decibels.

AIR Wind Module Specifications
rotor diameter —45 in.; **sphere of operation** — 48 in. ;**weight**— 13 lbs.; **length** — 26.5 in.; **startup wind speed** — 7 mph; **rated power** — 300 watts; peak power — 450 watts; **regulator set range** — 12-volt model: 13.8 to 17.8; 24-volt model: 26.0 to 36.0; fuse current — 12-volt model: 40 amps; 24-volt model: 20 amps

Inherit the wind. The ideal wind for the AIR Wind Module is a steady linear flow, which is more likely to be encountered in marine applications. On land, the wind flow can be disrupted by topography, trees, and other nearby structures. During our stay at the Imperial Dam LTVA, the wind was usually gusty,

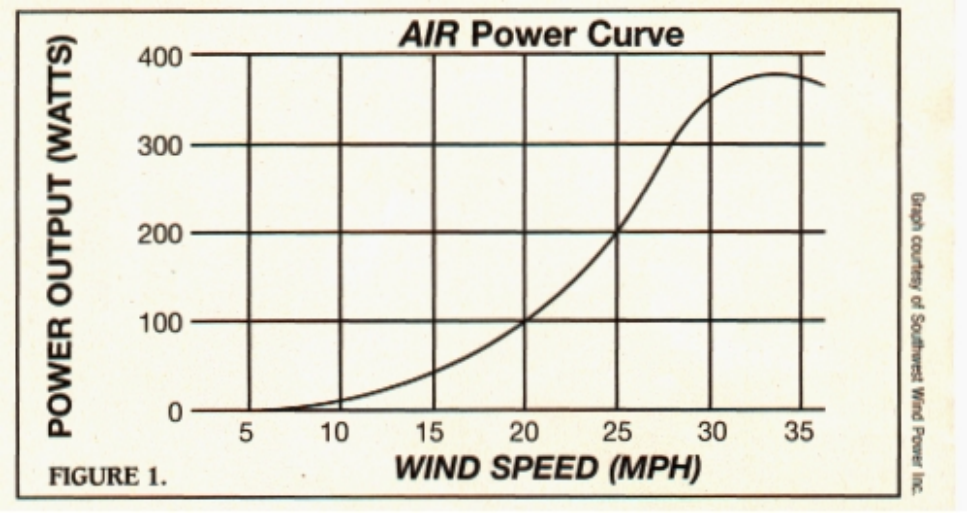

FIGURE 1.

and our maximum output for a 24-hour period was 313 amp-hours.

While heading to Pomona, California, last March for FMCA's winter convention, we had the opportunity to spend 48 hours in the Palm Springs area. Anyone who drove across Interstate 10 saw the huge fields of commercial wind generators and knows that this region can experience powerful winds. We were parked at a private residence atop a hill near Desert Hot Springs. The first day was not very windy, but the second day did not disappoint. From noon until the following morning, we encountered steady winds ranging from 20 to 35 mph with gusts up to 46 mph. The wind turbines put out a maximum of 60 amps and totaled 368 amp-hours over the 16-hour period. This experience validated the need for an adequate mount.

Freedom. Obviously, the effectiveness of the wind generator is dependent on the presence of wind, just as the effectiveness *of* solar panels is dependent on the sun. We were pleased with the performance of the AIR Wind Turbines and consider them a valuable part of our system.

The sun and wind have reduced the amount of time we need the diesel generator, but it continues to be an important part of our alternative energy sys tem. When the wind doesn't blow and the clouds hide the sun, we can always depend on the AC diesel generator to provide power.

There was a time when we attended rallies and envied motorhomers with hookups or those parked under a tree. How things have changed! We no longer seek or need hookups. Instead of perceiving sun and wind as uncomfortable conditions, we have turned them into *assets.* We can stay where we want for as long as we want. Our electrical system, with its alternative charging components, has given us our long-sought freedom.

For further information, contact Southwest Wind Power Inc., 2131 N. First, Flagstaff AZ86003; (520) 7799463, or Photocomm Inc., C703, an AIR Wind Module distributor at *P.0. Box 14230*
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(800) 44-6466.