

# Introduction



**P**hotovoltaic (PV) systems can work effectively for a variety of load applications. They are ideally suited to locations far from powerlines (Figure 1). They are also well suited to locations where the natural serenity would be destroyed by the noise of a diesel- or gas-powered generator.

Robi Robichaud has been in the field examining PV systems from Albuquerque to Missoula, talking to people who have installed, maintained, or used these systems. He has asked them what has worked well, what has not worked well, and what they might do differently. This report is a collection of tips and advice from people living and working with these systems.

A solar horizon device, such as the Solar Pathfinder, may be used to assess the relative importance of shading on site selection.

The Solar Pathfinder (Solar Pathfinder, Iron City, TN (931) 724-6528) shows where the sun shines in relation to the site objects for all the months of the year, so you can determine the effect of the shade from each object on total sunlight gathered.



Figure 1—Photovoltaic systems are ideally suited when power is needed far from powerlines. This panel powers an emergency phone system along the road to Mt. Evans on the Roosevelt National Forest in Colorado. The Colorado Department of Transportation shared the costs.

# Siting Considerations

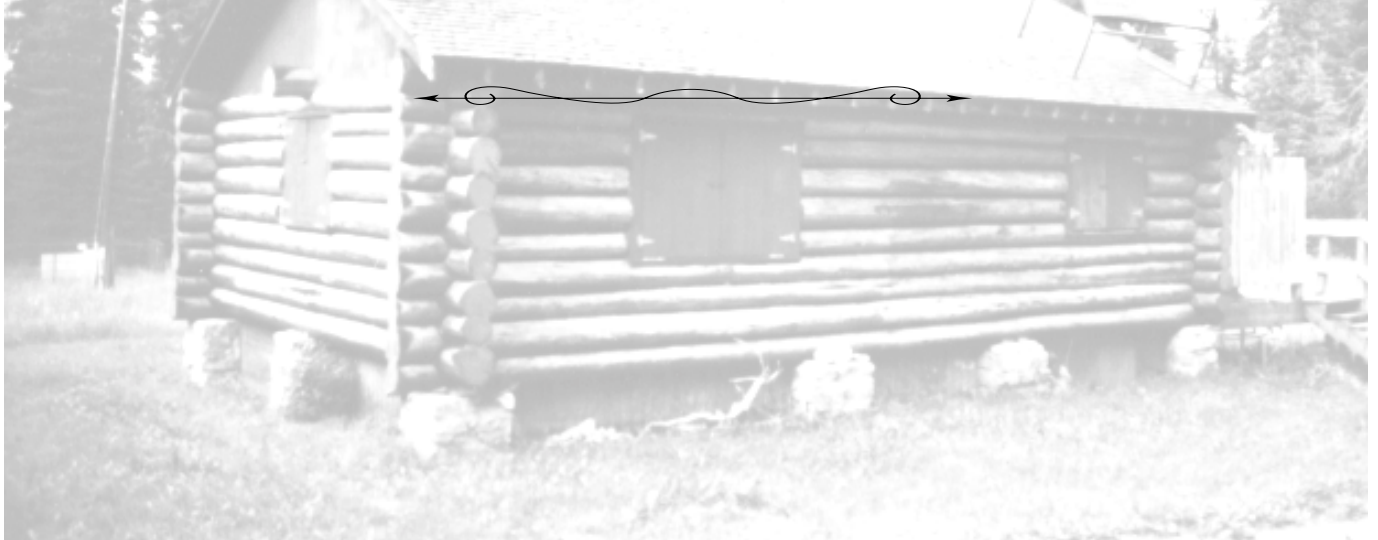
**C**onsider where trees or mountains are located. Are there trees or mountains to the east, west, or south that will shade the array during the day?

Because PV systems may be in use for a decade or longer, consider how tall trees will grow over the next 5, 10, or

even 20 years. A system that is not shaded at 1 p.m. today may be shaded in 7 years.

Another consideration is the proximity of the other parts of the system and the load to the photovoltaic array. Arrays typically generate low-voltage direct

current (DC) that undergoes some voltage drop (with power loss) when transmitted long distances. Low-voltage DC systems require heavier gauge wire than alternating current (AC) systems. Heavier gauge wire is needed to avoid voltage drops on DC systems. In general, the closer the array is to the other parts of your system, the better.



# Vandalism



**M**ethods of reducing vandalism include:

- Using campground hosts
- Screening the installation with fencing (figure 2) or shrubs and vines
- Using roof-mounted systems

For small systems on flat roofs, the array can be mounted near the middle of the roof with the components in watertight electrical boxes to reduce visibility and access to most components of your system.

For pitched roof systems, the relatively new “PV shingle” may be an answer to vandalism. These flexible panels are made of amorphous silicon and look like your average asphalt shingle (a variety of colors and shades are available). They withstand hail, snow, and wind better than traditional roof-mounted PV structures...and they require considerably more work to remove. The University of Denver, in conjunction with the National Renewable Energy Laboratory and others, recently installed a “roof-integrated” system at the Mt. Evans Observatory—the world’s highest observatory (Figure 3). Which may make this system the world’s highest PV system!

Solar tiles are another option for a roof-integrated solar system. The tiles use crystalline cells instead of amorphous cells, producing nearly twice as much power as the shingles.

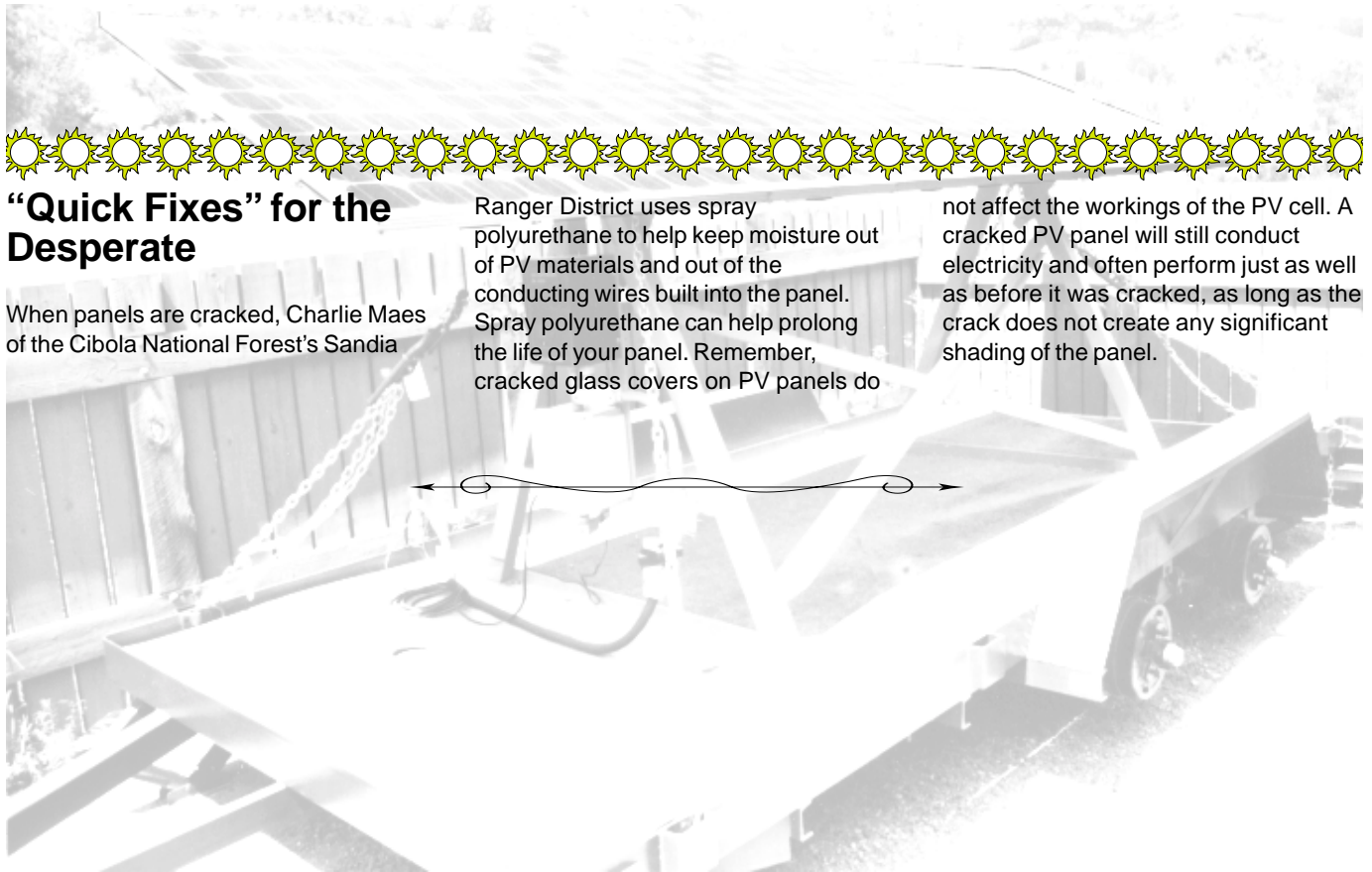
Lexan covers can protect typical PV panels in metal frames from damage by hail or rocks tossed by vandals. But Lexan can greatly reduce the sunlight striking the panels, especially when the sun is not perpendicular to the Lexan cover. A better way to provide protection is to select solar panels that have tempered glass coverings.



Figure 2—Fencing screens but doesn’t totally obscure solar panel installations such as this trailer-mounted array on the Roosevelt National Forest in Colorado.



Figure 3—Photovoltaic shingles produce electricity on the roof of the Mt. Evans Observatory on the Roosevelt National Forest in Colorado. The system uses 48 shingles, each 7 feet long.



## **“Quick Fixes” for the Desperate**

When panels are cracked, Charlie Maes of the Cibola National Forest’s Sandia

Ranger District uses spray polyurethane to help keep moisture out of PV materials and out of the conducting wires built into the panel. Spray polyurethane can help prolong the life of your panel. Remember, cracked glass covers on PV panels do

not affect the workings of the PV cell. A cracked PV panel will still conduct electricity and often perform just as well as before it was cracked, as long as the crack does not create any significant shading of the panel.