



Joshua Tree and Mojave Go Solar

Using renewable energy has lowered operating costs and dramatically reduced harmful emissions.

Until late 1998, Joshua Tree National Park and Mojave National Preserve in southern California used diesel generators to produce electricity in remote areas. Like many park energy systems, the diesel generators at Joshua Tree's Cottonwood Campground also produced potentially harmful emissions: 120 tons of carbon dioxide, 5,770 pounds of nitrous oxides, 286 pounds of sulfur dioxide, and 218 pounds of suspended particulates every year.

Today, Joshua Tree has cut those emissions dramatically while reducing annual operating costs by an impressive 90%, thanks to a new photovoltaic (PV) system that harnesses the sun's energy to produce clean electric power. Mojave has also had good results. And both parks continue to provide high-quality experiences for visitors while preserving our natural resources.

"We've had no trouble," said Harry Carpenter, chief of maintenance at Joshua Tree. "We're happy with the system—it works great."

This project was a combined effort of the Department of the Interior's National Park Service (NPS), Southern California Edison Company's (SCE) Utility Power Group, Sandia National Laboratories, the Department of Energy's Federal Energy Management Program (FEMP), and the National Renewable Energy Laboratory (NREL).

Joshua Tree's Carpenter and Mojave's Dave Paulissen worked with Renew the Parks, a cooperative effort between the NPS Denver Service Center and Sandia's Photovoltaic Design Assistance Center, to find the best renewable energy alternative for the parks. As a result, Joshua Tree and Mojave now have clean, cost-effective PV systems with simple payback periods of only 6.0 years and 8.1 years, respectively.

The Cottonwood Campground Project

Joshua Tree's Cottonwood Campground provides a good example of how these projects worked. It consists of a visitor center, three houses, a duplex, a maintenance building, two small offices, and two pads for campground hosts.

Two 32-kilowatt (kW) diesel generators provided power to the area, consuming about 10,000 gallons (38,000 liters) of diesel fuel per year at a cost of

\$10,950. Oil replacement every 250 hours added about \$1,450 annually for supplies and \$4,950 for labor. Annual generator replacement and overhaul costs were about \$9,600. The costs of emissions and potential fuel spills brought total estimated annual operating costs to \$49,770, or \$0.78/kWh.

Sandia recommended replacing the diesel system with a 21-kW PV array, a 250-kWh battery bank, a 30-kW inverter/battery charger, and a 30-kW back-up propane generator. These recommendations, costing about \$273,000 to implement fully, had estimated annual operating costs of only about \$4,000, with minimal generator use. Replacement batteries (\$25,000) would probably be required after about 10 years. Sandia also recommended that the

Technical Assistance

Success Story



A cost-effective, low-emissions photovoltaic array (below) replaced a diesel system at the Joshua Tree National Park Cottonwood Campground area (above).



Harry Carpenter, NREL/PIX07260

Harry Carpenter, NREL/PIX07261

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy



park switch to propane to increase system efficiency and identified several complementary conservation measures. FEMP and NREL were asked to help evaluate project financing options.

Innovative Project Financing

FEMP evaluated several alternatives, such as making use of agency funds, energy savings performance contracting, or utility programs. Using appropriated funds would have eliminated financing costs and provided the lowest life-cycle cost, with a discount rate of only 4.1% (in 1996), but funds were not available. Waiting even a few years for appropriations would have cost more in lost savings than the other options. Utility programs offered both technical and financing resources that could be leveraged to implement the project.

The Energy Policy Act of 1992 (Sec. 152) encourages Federal agencies and utilities to design cost-effective demand management and conservation incentive programs. In addition, Federal Acquisition Regulations (FAR) Sec. 41 authorizes agencies to enter into sole-source contracts with regulated utilities under established tariffs. At that time, SCE offered off-grid photovoltaics to Federal facilities through its "Experimental Schedule PVS" tariff—California Public Utilities Commission resolution E-3367.

That tariff allowed SCE to install PV systems, controls, batteries, mounting hardware, and other equipment for a fixed monthly service charge equal to 1.6% of the PV system installed cost (or 19.15% annually) for a term of 15 years. The utility assumed responsibility for system operation and maintenance, so park staff could focus their time and budgets on core mission activities.

Don Zieman, NPS public utility management chief, reviewed procurement and legal issues. Although FAR allows longer than 10-year terms when a tariff provides for it, NPS was more comfortable with a traditional 10-year term. So SCE agreed to 10 years with a 5-year renewal option. A buy-out schedule was also devised in case appropriations became available. And in fact, NPS was able to buy out the contract in the first year following installation.

NPS Solicitor Bill Silver resolved legal questions, and Jack Williams of the NPS Pacific Great Basin Support Systems Office gave the go-ahead to develop the contract. In September 1997, two contracts were signed to provide solar-generated electricity at Joshua Tree and Mojave.

Comparison of Diesel System and Current PV System at Joshua Tree (1996 numbers)

	Before	After
System	2 diesel generators (\$32,000)	21 kW PV array, 30-kW propane backup generator \$273,000
Fuel Costs/yr	\$10,950	\$1,100
Emissions/yr	5,770 lb (2,617 kg) NO _x 120 tons (109 metric tons) CO ₂ 286 lb (130 kg) SO ₂ 218 lb (99 kg) particulates	382 lb NO _x 7.6 tons (6.9 metric tons) CO ₂ 0 lb SO ₂ 0 lb particulates
Total Operating Costs/yr	\$49,770	\$4,065

*Note: The simple payback period for PV was 6.0 years.

Project Benefits

The PV systems are working well. The Joshua Tree system saves more than \$45,000 annually in operating costs. Carbon dioxide emissions are lower by more than 100 tons (90.1 metric tons) per year, NO_x emissions are lower by 5,387 lb (2,443 kg), and other emissions have been completely eliminated. Additional benefits include much less generator noise and fewer opportunities for costly spills during fuel transport. Dave Paulissen said that the Mojave system is working so well that another, larger PV system is planned for the Hole-in-the-Wall Fire Center nearby.

The PV systems improve visitors' experiences, reinforce NPS's position as a resource conservation leader, and serve as models for the efficient use of renewable energy. The accomplishments of Renew the Parks projects are being extended under the new Green Energy Parks program, a partnership of the Department of the Interior (through NPS) and the Department of Energy (through FEMP) that will help clear the air in more national parks and recreation areas for years to come.

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