

Photovoltaic electricity costs dropped from 90 cents per kilowatthour in 1980 to 20 cents per kilowatthour today. Since 1988, photovoltaic output has doubled; photovoltaic output increased another 24 percent just from 1993 to 1994. Maintaining and expanding this phenomenal growth depends on continuous improvements in the performance and cost-competitiveness of photovoltaic products, supported through cost-shared R&D between industry and the Department of Energy. At present, **every \$100 million in direct module photovoltaic sales helps support or create 3,800 U.S. jobs.**

### **Wind Turbine Technology**

Collaborative Department of Energy and industry research and development has created today's modern wind turbines, which are already providing sufficient electricity for 1 million Americans. Costs have been reduced from almost \$.25 per kilowatthour in 1980 to the current range of \$.05 to \$.07 per kilowatthour in locations with good wind resources. New wind turbine blades, advanced materials development, and developments in airfoil technology are expected to further reduce the cost of wind-generated electricity to \$.04 per kilowatthour by 2000. In California alone, there are more than 1,700 megawatts of generating capacity. California's wind powerplants **currently provide up to 8 percent of Pacific Gas and Electric's load and save the energy equivalent of 4.4 million barrels of oil each year while producing no air pollution.** (In fact, wind power prevents the creation of 2.5 million tons of carbon dioxide and 15,000 tons of other pollutants per year.

### **Wind Energy Analysis Systems**

A team of scientists at a Department of Energy laboratory produced and documented the most comprehensive analyses available of wind energy resources and wind electric potential in the United States. These analyses are used by utilities, energy planners, and industry. Team members also combined their skills to develop a measurement and analysis system for characterizing turbulence in the wind inflow to a turbine rotor. Efforts are now being extended across the globe to assist developing countries in establishing local wind energy projects. Data derived from the research also convinced the World Bank to include wind power as a viable option for a **\$600 million rural electrification project in Indonesia. This investment directly serves the Department of Energy missions of pollution prevention and increased energy efficiency.**

### **Geothermal Technologies**

The commercially operated geothermal site at The Geysers in northern California reached peak electric power output of 2,000 megawatts in 1988. Inexplicably, a steady decline in output began in 1989. In 1990, a concerned geothermal industry asked the Department of Energy for assistance in determining the cause. Failure of power production at The Geysers would have a depressing effect on all potential markets for geothermal power. During fiscal years 1990 through 1994, the Department of Energy shared costs with a coalition of geothermal operators and made available both experts and expertise to help diagnose the problem. The cause proved to be reservoir fluid depletion, the result of inadequate reinjection practices and insufficient knowledge of reservoir management requirements. The lessons learned in this effort will continue to benefit geothermal reservoir development for years to come. With a \$12 million Department of Energy investment--matched by \$42 million from industry--a potential crisis for hydrothermal energy systems was overcome, reservoir practices leading to **decades of stable operation were developed, and more than 300 jobs were directly preserved.**

### **Gas and Oil Exploration and Production Technologies**

Oil remains one of our Nation's vital commodities, supplying 40 percent of the United States' primary energy needs and nearly all of its transportation fuel. Domestic production, however, continues to decline, with two-thirds of all the oil ever found in the United States remaining unrecoverable by conventional production methods. Moreover, the United States has technically recoverable reserves of 113 billion barrels, almost 6 times today's proved reserves. In addition, as much as 1,300 trillion cubic