

# Renewables, Distributed Energy and Energy Storage

*Sandia National Laboratories*



*Help our nation secure a peaceful and free world through technology.*

Sandia has long been a pioneer in renewable energy technologies. Many programs date to the earliest days of research and development in renewables in the United States when the oil embargo of the mid-1970s sparked interest in alternatives to imported oil as our major source of energy. We continue to be a leader in renewables research and development. Sandia's work spans diverse technologies such as: photovoltaic and concentrating solar power, wind energy, geothermal systems, solar buildings, and distributed energy research. We coordinate these programs closely with industry, allowing us to develop strong partnerships and to focus research and development on major national needs. We cooperate with the Department of Energy (our primary sponsor), the National Renewable Energy Laboratory (NREL), and industry to strengthen the position of U.S. industry and to improve the manufacturability and cost competitiveness of renewable energy systems.

## Photovoltaics



Sandia's photovoltaic programs are part of the National Center for Photovoltaics, which unites much of the photovoltaic work in the United States into a working partnership. We are working to reduce the life-cycle cost of

photovoltaic systems, to improve their reliability, and to improve their value to the user. In the Photovoltaic sub-program at the Department of Energy (DOE), Sandia leads work in performance and reliability benchmarking, balance-of-systems, and systems engineering and analysis. We provide technical support to DOE in the deployment and validation of photovoltaic systems, and we provide technical assistance, accurate performance measurements, reliability testing, and evaluation to industry. We operate several state-of-the-art research facilities for testing and evaluating PV systems, modules, arrays, and balance-of-system components.

## Concentrating Solar Power (CSP)



Operating as Sun•Lab, a virtual laboratory comprising CSP groups at Sandia and NREL, Sandia's work focuses on three types of concentrating solar power systems: parabolic troughs, power towers, and

dish/engine systems. Power tower and trough systems produce bulk electricity in units of 50 MW or more while dish/engine systems may be deployed as distributed generation in sizes of 10 kW to 10 MW. The power from CSP systems can be "firmed" or made dispatchable by using thermal storage or through hybridizing the system with fossil fuels. The goals of Sun•Lab are aimed at reducing the cost of energy from CSP systems so that they can compete in U. S. and, eventually, worldwide power markets. To meet these goals, efforts are focused on improving reliability, reducing costs, and developing advanced components and systems, all in partnership with the CSP industry, utilities, and government stakeholders.

## Solar Buildings

Sandia provides manufacturing and technical support for DOE'S Solar Heating and Lighting sub-program. We work with existing



manufacturers to help address manufacturing and design problems. We also conduct work on the development of innovative and low-cost designs for solar hot water systems. All of our solar buildings' work is conducted in cooperation with the NREL.

## Sandia's National Solar Thermal Test Facility (NSTTF)



This facility is an important resource for users and manufacturers of Concentrating Solar Power systems. Manufacturers can use the facility to test new designs, ideas, and

products in an environment duplicating operating conditions.

## Wind Energy



Sandia specializes in all aspects of wind turbine blade design and system reliability. Activities are focused on reducing the cost of wind generated electricity and improving the reliability of systems operating

nationwide. Research disciplines include: materials, aerodynamics, aeroacoustics, stress analysis, fatigue analysis, structural analysis, reliability analysis, and manufacturing processes. By partnering with both universities and industry, Sandia has advanced the state of knowledge in the areas of materials, structurally efficient airfoil designs, active flow aerodynamic control, and sensors. Researchers at the laboratory are currently investigating integrated blade designs where airfoil shapes, blade planform, materials, manufacturing process, and embedded controls are all considered in a system perspective. By collaborating with operators, developers,

and manufacturers, Sandia evaluates known reliability problems and proactively determines future reliability issues through the creation and management of a reliability database. Additionally, the department has developed an instrumentation system that enables data to be collected from multiple sensors on a wind turbine and integrates the data into a seamless and continuous database. All these efforts are aimed at the DOE program goal to reduce the cost of wind energy.

### **Drilling Technology and Geothermal Systems**

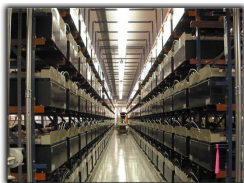


Sandia's work in drilling technology is aimed at reducing the cost and risk associated with drilling in harsh, subterranean environments. The historical focus of the drilling research has been directed at significantly expanding the nation's utilization of geothermal energy. This focus in geothermal related drilling research is the search for practical

solutions to challenges associated with tapping the most intense sources of heat, typically found well below the earth's surface in very severe environments. Because a large portion of the cost and risk of generating electricity from geothermal sources is associated with drilling and completing exploration, production, and injection wells, Sandia's primary focus has been on the development of improved drilling and completion technologies such as diagnostics while drilling, high-temperature electronics, advanced drill bit technologies, and wellbore integrity technologies to reduce and mitigate problems associated with loss of circulation. We also actively work on advanced drilling concepts to provide economical access to deeper and hotter resources in the future. Most of these research projects are conducted in cooperation with operators and companies within the well service industry. On a cost-per-foot basis, geothermal drilling is among the most expensive type of drilling performed; and Sandia's work this area has created natural synergies that benefit other industries and agencies (e.g., Oil & Gas and DOD) requiring drilled access to the underground.

### **Energy Storage**

The goal of the Energy Storage Systems program is to develop advanced energy storage systems in collaboration with industry to increase the reliability, performance and



competitiveness of the electric generation, transmission and distribution systems for both grid-tied and off-grid applications. The program develops advanced electric energy storage devices (batteries, flywheels, electrochemical capacitors, etc.),

power conditioning systems and controls, integrated into utility-scale storage systems. Both in-house and field testing are conducted in collaboration with partner utilities to evaluate performance under a variety of conditions. The program also investigates potential applications, benefits (both technical and economic), and costs of energy storage

### **Distributed Energy Research (DER)**



Sandia's Distributed Energy Technology Laboratory (DETL) tests technologies and control methodologies that will enable reliable distributed energy generation and use. DETL is a fully instrumented, configurable,

controlled, utility-interconnected test bed for study of a variety of issues that might be raised concerning the interactions of multiple, distributed technologies. DETL also includes extensive inverter test capabilities. Sandia focuses on assessing and improving information security for critical infrastructures including electric power systems. DETL provides hardware and controls as a part of this effort. In partnership with electric utilities, Sandia is developing detailed utility modeling at the distribution level (15 kV class), where distributed energy technologies are being introduced. Sandia is also studying Energy Surety Microgrid concepts in which multiple distributed energy devices are combined in a distribution circuit, separable from the main utility, to increase reliability, power quality, and reduce energy costs.

#### **For More Information Please Contact:**

##### **Solar Energy Technologies**

Jeff Nelson, 505-248-1715, [jsnelso@sandia.gov](mailto:jsnelso@sandia.gov)

##### **Photovoltaics**

Charley Hanley, 505-844-4453, [cjhanle@sandia.gov](mailto:cjhanle@sandia.gov)

##### **Concentrating Solar Power**

Tom Mancini, 505-844-8643, [trmanci@sandia.gov](mailto:trmanci@sandia.gov)

##### **Solar Buildings**

Greg Kolb, 505-844-1887, [gjkolb@sandia.gov](mailto:gjkolb@sandia.gov)

##### **Wind Energy Technology**

Jose Zayas, 505-284-9446, [jrzayas@sandia.gov](mailto:jrzayas@sandia.gov)

##### **Drilling Technology and Geothermal Systems**

Douglas Blankenship, 505-284-1230, [dabblank@sandia.gov](mailto:dabblank@sandia.gov)

##### **Distributed Energy Research and DETL**

Abbas Akhil 505-844-7308, [aaakhil@sandia.gov](mailto:aaakhil@sandia.gov)

##### **Energy Storage**

John Boyes, 505-845-7090, [jdboyes@sandia.gov](mailto:jdboyes@sandia.gov)

##### **Energy and Infrastructure Future**

Rush Robinett, 505-845-9015, [rdrubin@sandia.gov](mailto:rdrubin@sandia.gov)

##### **External website**

[www.sandia.gov/Renewable\\_Energy/renewable.htm](http://www.sandia.gov/Renewable_Energy/renewable.htm)

