

# PROGRAM facts

Power Systems  
Advanced Research

05/2008

U.S. DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY



## 2008 UNIVERSITY COAL RESEARCH PROGRAM

### Description

The University Coal Research (UCR) Program provides grants to U.S. colleges and universities to support fundamental research and to develop efficient and environmentally responsible fossil energy technologies. Funded by the U.S. Department of Energy (DOE) Office of Fossil Energy (FE), the program is carried out by DOE's National Energy Technology Laboratory (NETL).

The primary purpose of the UCR Program is to improve basic scientific and technical understanding of the chemical and physical processes involved in conversion and utilization of coal and coal by-products. Through the dedicated involvement of professors and students, the academic environment is conducive to generating fresh ideas and approaches, and holds great promise for yielding fundamental advancements in energy science and engineering.

The program also seeks to maintain U.S. leadership in a competitive global economy by strengthening vital educational and research capabilities of the Nation's universities, training the next generation of coal scientists and engineers by introducing them to coal technology research while advancing the science of clean energy.

Since 1979, when these grants first became available at congressional direction, more than \$125 million has been provided and more than 1,765 students have worked alongside their professors in 708 federally funded projects investigating long-term solutions for clean and efficient use of coal. These students have acquired and applied valuable experience in understanding the science and technology of coal, the Nation's most abundant fossil energy resource. Industry also is benefiting from this new technology and knowledge in such areas as computational energy dynamics and material sciences for advanced coal-based power systems.

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**Advanced Research** — To support coal and power systems development, NETL's Advanced Research Program conducts a range of pre-competitive research focused on breakthroughs in materials and processes, coal utilization science, sensors and controls, computational energy science, and bioprocessing — opening new avenues to gains in power plant efficiency, reliability, and environmental quality. NETL also sponsors cooperative educational initiatives in University Coal Research, Historically Black Colleges and Universities, and Other Minority Institutions.



## PROGRAM PARTICIPANTS

Auburn University

Case Western Reserve University

City College of City University of New York

Clarkson University

GE Energy

Georgia Institute of Technology (Georgia Tech)

Illinois Institute of Technology

Iowa State University

Leland Stanford Junior University (Stanford University)

Mississippi State University

Pennsylvania State University

Princeton University

Rensselaer Polytechnic Institute

Siemens Power Generation

Southern Illinois University

Tennessee Technological University

Texas A&M University

University of California at San Diego



Photo courtesy of Lawrence Berkeley National Laboratory.

*“The innovations coming out of the University Coal Research Program strengthen America’s energy security by enabling us to make better use of coal, our most abundant energy resource.”*

*—James Slutz  
Acting Principal Deputy Assistant Secretary for Fossil Energy*

## Program Areas

The UCR Program is organized into two elements:

**Core Research** — Annual program \funding opportunity announcements (FOA) encourage grant applicants to focus on innovative projects involving advanced concepts that are pertinent to fossil fuel conversion and utilization in areas that support NETL’s technology lines. The core research stimulates collaborative efforts for improving prospective U.S. commercial capabilities, and enhances the scientific and technical understanding of chemical and physical processes involved in conversion and utilization of fossil fuels. These efforts will broaden potential utilization of fossil energy resources and provide technological benefits for the U.S. commercial sector and the American consumer.

**Symposium** — Held jointly as part of an annual program review with NETL’s Historically Black Colleges and Universities and Other Minority Institutions (HBCU/OMI) Program, the symposium promotes the exchange of scientific and engineering information to enhance the educational training and research capabilities of participants, as well as to stimulate interest in these programs by others in the fields of science, engineering, and technical management.

## 2008 Projects

In fiscal year (FY) 2008, the UCR Program allocated \$560,000 for two coal-related research projects at two universities in two states. These projects will investigate technologies to improve the use of fossil energy through research that was solicited under one broad topic: Enabling Advanced Modeling and Simulation for Fuel-Flexible Combustors. From the proposals received, the maximum funding available to any of the applicants was \$276,264 for a 36-month performance period.

Descriptions of the FY2008 projects are as follows:

**Leland Stanford Junior University (Stanford University)**, Stanford, CA, is seeking to resolve various issues that prevent combustion large eddy simulation (LES) from being used as a primary tool for the design and optimization of turbine engine combustors, especially when using hydrogen derived from coal with variable levels of carbon monoxide (CO), methane (CH<sub>4</sub>) and diluents. (DOE award: \$276,264)

*The Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA, is investigating the sensitivity of transient thermo-acoustic CFD simulations that poorly define, or misrepresent, prescribed acoustic boundary conditions. (DOE award: \$276,256)*

## 2007 Projects

In FY2007, the UCR Program allocated nearly \$2.4 million for six coal-related research projects at six universities in six states. The selected projects focused on technologies in three areas: instrumentation (sensors and controls), computational energy sciences, and materials sciences. Four projects were selected to receive up to \$300,000 to work alone or in collaboration with another college or university. Two projects were selected for joint efforts in which, at a minimum, three colleges or universities (or two colleges or universities and an industrial partner) could receive a maximum of \$600,000. The six projects, all of which were to be performed over 36 months, are described below:

**University of Central Florida**, Orlando, FL, is seeking to develop an optical technique to measure temperature and pressure in hazardous environments. This project includes a comprehensive theoretical and experimental study of the temporal dynamics of single-crystal silicon carbide; a subtask to design, build, and test basic sensors based on single-crystal silicon carbide chips; and a subtask to design a networked sensor system to measure temperature and pressure in different zones of an extreme-environment power plant. (DOE award: \$300,000)

**Georgia Institute of Technology (Georgia Tech)**, Atlanta, GA, has joined with The Pennsylvania State University, GE Energy, and Siemens Power Generation to develop a design tool that can predict flashback and combustion instability in gas turbines operating on coal-derived high-hydrogen fuels. (DOE award: \$600,000)

**Princeton University**, Princeton, NJ, has teamed with Iowa State University and City College of City University of New York, on a joint computational, experimental, and theoretical effort to understand the frictional flow of granular materials. (DOE award: \$600,000)

**Rensselaer Polytechnic Institute**, Troy, NY, is seeking to develop steady-state and dynamic simulations of an integrated gasification combined cycle (IGCC) plant; assess the steady-state and dynamic operability of the plant under various power load and coal quality conditions; and develop model predictive control and multiple model predictive control strategies to improve the dynamic operation of these power plants. (DOE award: \$300,000)

**University of Notre Dame**, Notre Dame, IN, is employing computer-aided design to investigate materials for use in future high-temperature power-plant applications for developing a multiscale simulation tool to analyze the properties of silicon carbide-silicon nitride nanoceramic matrix composites. (DOE award: \$300,000)

## PROGRAM PARTICIPANTS (CONT.)

University of Central Florida

University of Cincinnati

University of Connecticut

University of Dayton

University of Houston

University of Iowa

University of Maryland

University of Notre Dame

University of Southern California

University of Tennessee

University of Tulsa

University of Utah

University of Wisconsin

Virginia Polytechnic Institute and State University (Virginia Tech)

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**University of California at San Diego**, La Jolla, CA, is conducting experimental studies for the development of joining methodologies (inertial welding for butt-joint configurations and magnetic pulse welding for lap, overlay, or cladding welds) for nickel-based (Ni) and oxide dispersion strengthened (ODS) tubes while preserving near-baseline creep performance in the weld region. (DOE award: \$265,000)

## Earlier Awards

The eight grant projects listed on the previous pages are those awarded under DOE/FE's UCR Program in the two most recent years. Projects awarded in previous years are described in the following UCR Program fact sheets:

2006 University Coal Research Program (Program088.indd)

2004 University Coal Research Program (Prog005.pmd)

All of these fact sheets may be accessed electronically through the following link to the NETL Advanced Research Reference Shelf:

<http://www.netl.doe.gov/technologies/coalpower/advresearch/ref-shelf.html>



Additional details on each of the projects included in this program can be found on the Department of Energy's Fossil Energy Website at:  
<http://www.fe.doe.gov/techline/techlines/Index.html>