



the **ENERGY** lab

PROGRAM FACTS

Power Systems
Advanced Research

2009 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, approximately \$130 million has been provided and nearly 1,800 students have worked alongside their professors on 722 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.

Advanced Research—

To support coal and power systems development, NETL's Advanced Research Program conducts a range of 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. Besides the UCR Program, NETL also sponsors cooperative educational initiatives with Historically Black Colleges and Universities and Other Minority Institutions.

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U.S. DEPARTMENT OF
ENERGY

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
Northwestern University
Ohio State University
Pennsylvania State University
Princeton University
Rensselaer Polytechnic Institute
Siemens Power Generation
Southern Illinois University
Tennessee Technological University
Texas A&M University
University at Albany, SUNY
University of California at San Diego
University of Central Florida
University of Cincinnati
University of Connecticut
University of Dayton
University of Florida
University of Houston
University of Iowa
University of Maryland
University of Michigan



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 A. Slutz,
Acting 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.

2009 Projects

DOE is providing almost \$2.4 million in fiscal year (FY) 2009 to co-fund coal-related research projects at six universities in eight states. These projects were selected from three broad areas: Computational Energy Sciences, Material Science, and Novel Materials for Sensing or Monitoring in Extreme Environments of Fossil Energy Systems. Maximum funding available for any one of these 36-month projects was \$300,000. Descriptions of the FY 2009 projects are as follows:

The University of Michigan, Ann Arbor, MI, has teamed with the University of Florida to physically model and experimentally verify the flow from horizontal gas jets injected into a two-dimensional bubbling fluidized bed of non-spherical particles, in order to expand NETL's MFIX (Multiphase Flow with Interphase eXchanges) computational tool by adding features needed to design and analyze gas jets in industrial fluidized beds. (DOE award: \$297,709)

The Ohio State University, Columbus, OH, will seek to develop an ASPEN Plus® plant process model integrated with FLUENT® equipment models via the CAPE-OPEN standard that can accurately and conveniently simulate the operation of coal-derived synthesis gas (syngas) chemical looping reactor systems for both combustion and gasification, potentially providing insight into overall looping process performance as well as individual equipment operations. (DOE award: \$299,819)

The University of Texas at Dallas, Richardson, TX, will prepare novel mixed-matrix membranes based on polymer composites with nanoparticles of zeolitic imidazolate frameworks (ZIF) and related hybrid frameworks, and use the membranes containing these new materials to achieve unprecedented transport of gases and to evaluate separations important to coal gasification (e.g., hydrogen, carbon monoxide, oxygen, and carbon dioxide). (DOE award: \$299,974)

The University of Tennessee, Knoxville, TN, will collaborate with Northwestern University by utilizing modern computational tools, integrated with focused experiments, to design innovative, high-temperature, creep-resistant ferritic superalloys strengthened mainly by nickel-aluminum-type precipitates for advanced fossil-energy systems, in order to help improve the thermal efficiency of steam turbines. (DOE award: \$300,000)

The Research Foundation, University at Albany, State University of New York (SUNY), Albany, NY, is proposing to use a novel, plasmonics-based, all-optical gas sensing technique that utilizes the optical properties of tailored nanomaterials as the sensing layer in order to enhance the detection selectivity of these films and overcome material incompatibility challenges posed by conventional sensors under harsh environmental conditions such as those found in gas turbines, solid oxide fuel cells, gas reformers, or other ancillary equipment at advanced, coal-fired power plants. (DOE award: \$300,000)

The University of Cincinnati, Cincinnati, OH, is collaborating with the Missouri University of Science and Technology to investigate and demonstrate two new types of doped-ceramic, nanofilm-coated, optical fiber chemical sensors that will possess desired stability, sensitivity, and selectivity for in-situ, rapid gas detection in coal-derived syngas streams, focusing particularly on sensors for detection of hydrogen and hydrogen sulfide at high temperatures and pressures. (DOE award: \$299,915)

PROGRAM PARTICIPANTS (cont.)

University of Notre Dame

University of Southern California

University of Tennessee

University of Texas at Dallas

University of Tulsa

University of Utah

University of Wisconsin

Virginia Polytechnic Institute and
State University (Virginia Tech)

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>

2008 Projects

In 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 FY 2008 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 (CH₄) 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)

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:

- 2008 University Coal Research Program (May 2008)
- 2006 University Coal Research Program (May 2007)
- 2004 University Coal Research Program (January 2005)

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>

