DOE Funds 20th Year of University Coal Research Grants

Students, Teachers Team to Explore Greenhouse Gas Reduction, Coal Science and Pollution Free Power Plant

The U.S. Department of Energy announced today that 17 university-proposed projects will share in $2.8 million in federal coal research funds - marking the 20th year of a program that combines science education for students with research that can reveal cleaner and more effective ways to use the nation's plentiful coal reserves.

The winning colleges and universities include:

- Arizona State University
- Brigham Young University
- Brown University
- Carnegie Mellon University
- Clarkson University
- Colorado School of Mines
- Georgia Institute of Technology
- Kansas State University
- Ohio University
- Pennsylvania State University
- State University of New York
- University of Akron
- Iowa State University (2 projects)
- University of North Dakota
- Washington University
- West Virginia University

The 17 projects, selected in a national competition run by the Energy Department, will be conducted in colleges and universities in 12 states. Private sector sources will provide an additional $692,336 for projects that range from fundamental studies of coal science to support for a futuristic, pollution-free coal plant.

The University Coal Research program began in 1979 as an Energy Department initiative to encourage college-level science and engineering students to team with professors in exploratory coal research. Since then, approximately 1,340 students have been part of the program and nearly 1,290 of them have already gone on to receive science or engineering degrees. These 17 projects,
brings the total federal awards during the two decades of the program to 553 grants with a combined public-private sector value of about $96 million.

The 1999 winning proposals were selected from 51 applications that were judged by peer review teams consisting of 36 academic, industrial and government coal experts. Actual grant awards are expected to be in place by July.

Twelve of the university teams will conduct research that supports the Energy Department's "core program" in coal science, utilization and the "Vision 21" concept. "Vision 21" is the Energy Department's long-range concept for ultra-clean energy plants that could be customized to co-produce electric power, fuels, chemicals and other high value products from coal. A key goal of the "Vision 21" concept is the near-zero release of emissions - including greenhouse gases such as carbon dioxide - by the year 2015.

The other five project teams will receive smaller grants for longer-range, more exploratory research that could lead to future breakthroughs. The projects include research into intriguing concepts for capturing greenhouse gases and innovative ideas for future energy and power cycles.

Details on the individual projects follow.

1999 University Coal Research - Winning Projects
Project Descriptions

CORE PROGRAM

- **Improved hot gas contaminant and particulate removal techniques** are needed because current technologies for gas cleanup, and particulate control in plants with integrated gasification combined cycle technology (one of the "Vision 21" advanced power plant options) limits overall plant efficiencies. Four projects were selected to address these concerns in this area:
  - **Iowa State University in Ames, Iowa** will receive **$200,000** from DOE and will contribute an additional **$122,311** to examine the formation of dust cakes to improve the performance of moving bed granular filters for hot gas clean-up. The contact at Iowa State University is Richard E. Hasbrook at (515) 294-5225.
  - In a second project to the same school, **Iowa State University** will receive **$200,000** from DOE and will contribute an additional **$103,076** to examine methods for producing a regenerable, superior calcium-based sorbent for cleaning hot gas in integrated gasification combined cycle systems.
  - **University of North Dakota in Grand Forks, North Dakota**, will receive **$192,363** from DOE to develop an electrostatic barrier filter collection system that can withstand temperatures above 1500 degrees F and be compatible with various sorbent injection schemes for sulfur and alkali controls. The contact at the University is Dr. John Erjavec, (701) 777-3797.
  - **Georgia Institute of Technology in Atlanta, Georgia**, will receive **$198,860** from DOE to investigate the removal of hydrogen sulfide from coal gasification...
process streams and optimize high temperature desulfurization processes using an electrochemical membrane. The contact at Georgia Institute of Technology is Dr. Jack Winnick at (404) 894-2839.

- **Ambient PM2.5 sampling and sorting** is important because measurement of the concentration, chemical composition, and physical characteristics of fine particles, smaller than 2.5 microns [PM2.5], is a necessary component of a national strategy to better understand the links between emissions and their impact on human health and the environment. Under this topic research will be conducted by two universities:
  - **Carnegie Mellon University, in Pittsburgh, Pennsylvania**, will receive $199,948 from DOE to study the uncertainties that exist in both the primary fine particulate emissions from coal-fired boilers and the formation of secondary aerosols, a complex mixture of particles from numerous sources. The objective of this study is to design and build a state-of-the-art dilute sampler to investigate PM2.5 emissions from a pilot-scale coal combustor under different conditions to compare theoretical and experimental particle formation. The contact at Carnegie Mellon is Allen Robinson at (412) 268-3657.
  - **Brigham Young University in Provo, Utah**, will receive $198,747 from DOE and will contribute an additional $78,844 to determine the impact to human health from airborne gases produced during coal burning. The contact at the University is Gary Reynolds at (801) 378-6177.

- **Production of premium carbon products from coal** is necessary because the United States and global markets for carbon and carbon products are increasing significantly. It is economically and strategically desirable to find processes that use coal -- a low cost, abundant feedstock -- for carbon products. Two universities were selected to investigate methods for developing premium carbon products:
  - **Brown University in Providence, Rhode Island**, will receive $199,588 from DOE to examine coal types, preparation conditions, mineral content, and burning patterns to better understand the influence of pores in the coal on how well different coals burn. The contact at Brown University is Norman Hebert, (401) 863-3141.
  - **Pennsylvania State University in State College, Pennsylvania**, will receive $199,928 from DOE and will contribute an additional $116,587 to systematically study the chemical and physical properties of coal combustion by-products to determine commercial applications of the adsorbent material products from several different combustion processes. The contact at the Pennsylvania State University is Harold Schobert at (814) 863-1337.

- **Advanced diagnostics and modeling techniques for three-phase slurry reactors (called bubble columns)** predict the chemical profiles necessary for scaling up the process for converting coal-derived synthetic gas to a liquid fuel. Two universities were selected under this topic:
  - **Washington University in St. Louis, Missouri, teaming with Ohio State University in Columbus, Ohio, and Air Products and Chemicals**, will receive $380,095 from DOE and will contribute an additional $168,390 to use advanced
diagnostics techniques in an attempt to resolve problems of slurry bubble column reactors under certain reaction conditions to generate a new approach for scale-up and design of new reactors. The contact at Washington University is Cynthia White, (314) 935-5825.

- **Clarkson University in Potsdam, New York**, will receive **$200,000** from DOE and will contribute an additional **$39,320** to investigate slurry phase Fischer-Tropsch processing for developing an advanced computational model for predicting the behavior of dense mixtures in coal liquefaction, gasification, and liquid fuel production. The contact at the University is Goodarz Ahmadi at (315) 268-2322.

- **Advanced hydrogen separation technologies** research supports all proposed "Vision 21" plant configurations which produce hydrogen either as a product, for power production in a fuel cell, or as a reactant to produce fuels and chemicals. Better hydrogen separation technologies can significantly affect the economics of the plant and reduce downtime due to maintenance and failures. One university was selected in this area:
  - **Colorado School of Mines in Golden, Colorado**, will receive **$200,000** from DOE to develop and fine-tune sulfur resistant palladium-copper composite membranes that can be applied to high temperature high purity hydrogen separation. The contact at Colorado School of Mines is Robert McCormick at (303) 273-3967.

- **Water gas shift with integrated hydrogen/carbon dioxide (H2/CO2) separation process** is seeking options for removing carbon from coal before combustion as an alternative approach to reducing greenhouse gases from power generation and offers the promise of making hydrogen from coal with zero pollution for fuel cell and other applications. One award was made in this area:
  - **State University of New York in Buffalo, New York**, will receive **$194,762** from DOE to examine the kinetics of the reaction for removing CO2 and separating the hydrogen into a single processing vessel. The contact at the University is Carl Lund at (716) 645-2977.

**INNOVATIVE CONCEPTS PROGRAM**

Another five projects will receive grants of up to $50,000 under the Innovative Concepts Program. Through this program, the Department is seeking to explore novel concepts that would offer prospects for research breakthroughs in areas the following areas:

- Novel CO2 capture and separation schemes address concerns about Global Climate Change and the possible impact of carbon dioxide (CO2) emissions. "Vision 21" plants are able to take advantage of integrated design to facilitate CO2 capture and separation. Three projects are awarded under this area:
  - **The Ohio University in Athens, Ohio**, will receive **$50,000** from DOE and will contribute an additional **$27,610** to consider how to use algae to recycle CO2 from emissions gases from coal-fired power plants using wet scrubbers. The contact at the University is David J. Bayless, (740) 593-0264.
University of Akron in Akron, Ohio, will receive $50,000 from DOE and will contribute an additional $9,350 to study the feasibility of storing and recycling CO2 by photosynthesis and paving the way toward visible light photosynthesis under practical flue gas conditions. The contact at the University of Akron is Gerald Parker at (330) 972-6764.

Arizona State University in Tempe, Arizona, will receive $47,884 from DOE and will contribute an additional $16,209 to investigate advanced computational modeling for identifying key factors that govern mineral carbonation kinetics for safe capture and long term CO2 sequestration. The contact at Arizona State University is Andrew Chizmeshya at (602) 965-6072.

Identification of promising "Vision 21" configurations encompasses the idea of interchangeable modules that are capable of assembly into various configurations that may co-produce power and fuels, chemicals, or other high value products. The configurations, which appear to be most likely to be commercialized, at first, may not include all potential applications of the "Vision 21" concept. One project was selected in this area:

West Virginia University in Morgantown, West Virginia, will receive $50,000 from DOE to investigate using coal as a scrubbing medium in place of lime. This concept is a multi-step process that captures sulfur dioxide and oxidizes it to sulfate while reducing pyritic sulfur from the coal. The contact at WVU is Allan B. Martin at (304) 293-3998.

Efficient power cycles research seeks to improve the thermal efficiency of a system with two working fluids: ammonia and water. This is important because more efficient cycles mean lowered power production costs.

Kansas State University in Manhattan, Kansas, will receive $42,048 from DOE and will contribute an additional $10,639 to investigate increasing cycle efficiency, cost, ease of handling, toxicity, and environmental concerns for providing the basis for conceptual design of a heat exchanger that optimizes heat recovery from flue gas. The contact at the University is Stephen M. Bajorek at (785) 532-2607.