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OAQDA Approves \$2.03 Million for University-based Clean Coal Research Projects *12 approved grants reflect priority shift toward CO₂ capture and sequestration*

(Columbus) In awarding 12 clean coal grants to four Ohio universities, the Ohio Coal Development Office (OCDO) chose to further align its Strategic Plan with that of the Fossil Energy Program of the U.S. Department of Energy (USDOE). The shift places greater emphasis on projects that address carbon dioxide capture and sequestration, as well as oxygen separation from air and conversion of coal to other fuels. The grants were authorized at the July meeting of the Ohio Air Quality Development Authority (OAQDA)

OAQDA authorized a total \$2,034,728 in grants from OCDO, a program of OAQDA, for clean coal research projects at the University of Akron, Case Western Reserve University, the University of Cincinnati and The Ohio State University. As in the past, Ohio University received funding to administer the coal projects over the next two years.

The priority shift reflected in the approved projects focuses on the most pressing clean coal challenges and underscores increasing interest at the federal and state levels to prepare for anticipated federal carbon restraints.

Another program redirection involved combining the fuel cell work being conducted at Akron University and The Ohio State University into one collaborative coal fuel cell program. The three professors engaged in the research will investigate different aspects of the coal fuel cell.

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“Ohio’s universities already have been engaged in conducting research into cutting-edge technologies that will help Ohio and the nation in dealing with carbon management and containment and other pressing priorities. The projects authorized this month also reflect the objectives of the OCDO Strategic Plan, including maximizing the use of coal beyond electricity generation to meet Ohio’s energy needs and reducing the environmental impact of continued coal usage,” said Mark R. Shanahan, OAQDA executive director and the Governor’s energy advisor.

All 12 projects were reviewed and recommended for funding by the Ohio Coal Research Consortium review team and by OCDO’s director, staff and Technical Advisory Committee. The 12 projects are listed below.

Carbon dioxide capture and sequestration

- \$159,786 for a continuation project at **Case Western Reserve University** that evaluates the potential for leakage of CO₂ contaminated with sulfur dioxide, oxygen and other flue gas components after injection into Ohio’s deep saline aquifers. The two-year project will measure the solubility of CO₂ in brine and the rates of reaction of this solution with minerals found in possible CO₂ storage reservoirs in Ohio and also develop computer models to estimate the risk of CO₂ migration. University share: \$46,044.
- \$160,000 for a continuation of support for a project of **The Ohio State University** involving the iron-based chemical looping process, which directly converts coal into hydrogen with an off-stream of sequestration-ready CO₂. To date, the system has been demonstrated at the bench scale of 2.5 KWth (kilowatt thermal). The goal of this two-year project is to develop a prototype coal handling and feeding system that can be suitable to the 25 KWth to 1 MWth sub-pilot range. University share: \$40,034.
- \$160,000 for a two-year project at **The Ohio State University** to address optimization of reactor conditions in a CO₂ capture system demonstrated in prior OCDO-funded projects. The process uses calcium oxide to capture CO₂ at elevated temperatures so that the heat can be used for electricity generation. It also renders a pure stream of CO₂ ready for sequestration. University share: \$45,013.

Oxygen separation

- \$160,000 for a two-year project at the **University of Cincinnati** to continue research into the development of membranes that can reduce the cost for separation of oxygen from air in oxy-fired coal combustion. This project will support past work by fine-tuning membrane pore size through use of zeolite membranes. University share: \$40,284.

- \$160,000 for a two-year project at the **University of Cincinnati** for the development of a membrane for use in the separation of oxygen from air. This proposal differs from the above project at the university in the form of zeolite to be evaluated. Also, this proposal will emphasize reducing the thickness of the membrane to enhance the oxygen flow rate. Researchers will address separation issues, including the extended time required for membrane synthesis that leads to higher costs as well as the large membrane thickness and existence of inter-crystalline pores that lower separation performance. University share: \$57,175.
- \$160,000 for a two-year project at **The Ohio State University** to reduce the cost of separation of oxygen from air in oxy-fired coal combustion. The proposed approach is to place a nano layer of dense membranes between two porous support layers made of materials easily fabricated into shapes required for oxygen separation processes. The project's goal is to fabricate these membranes in tubular shapes to facilitate the building of bench-scale test set-ups for demonstration to potential commercialization partners. University share: \$40,000.

Conversion of coal to hydrogen

- \$80,000 for a one-year continuation of a project at the **University of Cincinnati** to demonstrate high-temperature water-gas shift reactors that do not require catalysts for conversion of syngas to hydrogen. The basis of the concept is development of a zeolite membrane for separation of CO₂ and hydrogen, thus driving the desired reaction to completion. The reactor has performed well to date, although membrane performance has dropped 18 percent. The goal of the remaining year is to work to stabilize the membrane and improve reactivity. University share: \$20,000.

Coal fuel cells

These three projects comprise the new coal-based fuel cell collaborative program between the **University of Akron** and **The Ohio State University**. The first task will be to work out intellectual property issues and a common statement of work. The primary problems holding up progress on the coal fuel cell have been fabrication of the cell button and elimination of pinhole air leaks where the reactive button is attached to the cylinder that completes the cell assembly. The goal of the collaboration is to use the unique expertise of the principal researchers at each university to resolve techniques for fabrication of cells with reproducible performance and greater reactivity.

- \$160,000 for the two-year “coal-based fuel cell efficiency and overall concept” project at the **University of Akron**. University share: \$40,000.
- \$159,993 for the two-year “coal-based fuel cell catalysts” project at **The Ohio State University**. University share: \$40,920.
- \$160,000 for the two-year “coal-based fuel cell supports” project at **The Ohio State University**. University share:\$40,000.

Other projects:

- \$160,000 for continuation of an iron-based chemical looping project at **The Ohio State University** aimed at increasing the reactivity of the iron oxide particles in the chemical looping process so that the size of the reactors may be reduced. This two-year project will be a fundamental study involving quantum theory to try to understand how oxygen moves into and out of iron particles and to increase the rate at which it does. The Consortium directed that a consultant who specializes in this field be added to the project team, and the principal researcher has agreed to this redirection. University share: \$40,034.
- \$80,000 for the one-year continuation of a prior two-year project at **The Ohio State University** to develop reduced-temperature cathodes for syngas fuel cells. The project’s goal is developing stable cathode catalyst formulations that have improved oxygen-activation and –reduction properties at lower temperatures, enabling lower operating temperatures and, thus, more flexibility in terms of materials and costs. This one-year extension is a “redirection” by the Consortium to reflect a priority shift away from processes dependent on the production of syngas. University share: \$20,000.

Of the total \$2,034,728 authorized by OAQDA for clean coal research, \$1,759,792 will co-fund the above projects. The remaining \$274,936 was authorized to cover **Ohio University’s** administrative and technical assistance budget to oversee the research projects and for outside consultants as needed and investigator travel costs.

The Ohio Air Quality Development Authority (OAQDA) is a non-regulatory government agency created to help Ohio businesses comply with clean air regulations. Through its Ohio Coal Development Office, OAQDA also oversees the State of Ohio’s coal research, development and technology deployment efforts. Since its creation in 1970, the Authority has provided technical and financial help to hundreds of large and small Ohio businesses, awarding more than \$7 billion to finance air quality projects. In addition, the OAQDA executive director was appointed the Governor’s energy advisor in January 2007. Subsequently, in 2008, OAQDA was named as administering authority for the \$150 million Advanced Energy Job Stimulus Program. For more information about OAQDA and its services, please visit its web site at www.ohioairquality.org.

