R & D facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Office of Research and Development

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University Research Initiative

The National Energy Technology Laboratory is collaborating with universities to overcome a growing national problem. While energy is the cornerstone of the nation's economy, recent collegiate trends have shown a decreasing interest in science and engineering, more specifically in the energy and energy-related environmental arenas. Building on long standing relationships with major universities (Carnegie Mellon and University of Pittsburgh in Pittsburgh, PA, and West Virginia University in Morgantown, WV), NETL has taken steps to continue and expand upon university collaborations with its Office of Research and Development, with a focus on coal and power system research.

NETL has entered into 50 collaborative projects since 2005, where university and NETL researchers work side-by-side on an ongoing basis for the duration of each project. Unlike other programs where "visiting" students spend a week or month conducting research in a government or private laboratory, this program establishes long-term relationships between the university and NETL researchers. They work collaboratively on projects ranging from materials development, to mathematical simulations, control systems, and process development. All research for these projects is being conducted at NETL laboratories in Morgantown and Pittsburgh.

Building closer ties with the local universities helps to prepare the next generation of scientists and engineers who will address the next generation of challenges related to fossil fuel use. Through these collaborations, NETL hopes to tap the kind of student talent for medicine, computers, and robotics that is drawn to these major regional universities, and apply that talent in the energy arena. A goal of the university participants is to allow students the opportunity to view real-world issues and experience research in a non-academic setting. These collaborations are a natural outgrowth for a region that has a rich energy history. This new collaborative program will further distinguish the tri-state region as the research center for clean coal technologies in the 21st century.

Projects support research needs for technologies ranging from materials development to modeling, sensors and controls, process simulations, fuel cells, gas hydrates, and measurement, mitigation and verification. The first phase of project awards resulted in 18 individual projects. The second phase had an added component that required each project to involve at least two of the three universities, and resulted in the award of 32 projects. All projects are negotiated for a one-year initial period, with options to extend for additional one-year increments. The list of projects reflects needs in fossil energy programs such as Hydrogen Storage and Transportation, Carbon Sequestration, Gas Turbines, Combustion Science, Advanced Fuels, Water Management, Security Systems Analysis, Infrastructure Security, and Coal Supply Vulnerability.

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WVU PhD student Alex Tsai and NETL researcher Dave Tucker describe the hybrid turbine/fuel cell research to Secretary of Energy Samuel Bodman.

For example, one project with the University of Pittsburgh has a goal of improving the existing understanding of the properties of methane hydrates. This collaboration is focusing on fundamental modeling studies, and could lead to potential hydrocarbon production from the vast untapped methane hydrate reserves. According to some estimates, the energy locked up in methane hydrate deposits is more than twice the global reserves of all conventional gas, oil, and coal deposits combined.

University of Pittsburgh student in NETL's hydrates thermoconductivity laboratory

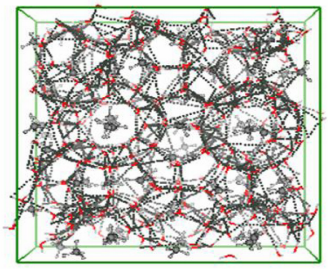

Image of methane hydrate structure, derived from modeling data (100 million "Monte Carlo" calculations) collected at the molecular level. These experiments will help develop methods to extract methane from the ice crystal safely and efficiently.

Grant Bromhal, NETL, and Martin Ferer, WVU, check CT scanner installation at NETL

A joint Carnegie Mellon University (CMU) Engineering and West Virginia University (WVU) Physics project is focusing on geological sequestration and oil and gas extraction and production. This collaboration is joining NETL's onsite computed tomography (CT) imaging research with WVU simulations and CMU microfluids experiments. Participants are combining their computational modeling expertise with NETL expertise to study the internal flows of potential carbon sequestration reservoir materials, to develop and validate models. The resulting data and the mathematical models derived from that data will be used to ensure that when carbon dioxide is injected in geological formations, it remains sequestered and does not escape.

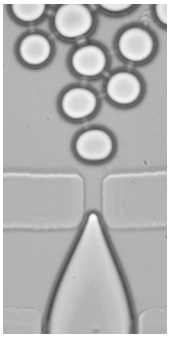

Image of injection of fluid into a micromodel constructed at Carnegie Mellon University. The experiment simulates the injection of carbon dioxide into a brine-saturated geologic formation.

Hybrid turbine/fuel cell experiment at NETL

In a third project, WVU researchers are investigating hybrid turbine-fuel cell control development. This collaboration is combining WVU control expertise with NETL hybrid experimental studies. Utilizing waste heat from the turbine to preheat fuel entering the fuel cell leads to a combined system efficiency that is greater than each stand-alone device could achieve. Further research is needed to determine how fuel cells respond to routine turbine transient conditions (such as differences between start-up and shut-down conditions).