

March 5-7, 2008

ITEM 136-2002-R0907: Authorization to Establish The Montana State University-Bozeman Energy Research Institute

THAT: The Board of Regents of Higher Education authorizes the establishment of The Montana State University-Bozeman Energy Research Institute.

EXPLANATION AND RATIONALE: The Montana State University-Bozeman Energy Research Institute will be the umbrella institute for an array of energy research and education programs at Montana State University-Bozeman. Over the past several years, MSU-Bozeman has developed numerous programs focused on energy research, education, and development, and is now playing a significant role in international and national energy research and development.

MSU-Bozeman currently has highly relevant research and education programs in carbon sequestration, fuel cell technology, biofuels, and wind energy. These programs focus on the identification of clean coal technologies and alternative energy resources that are crucial to the state's and the nation's future economic development. Montana is fortunate to have vast quantities of fossil fuels, including coal, oil, and gas. Over 50% of the electricity produced in the United States is derived from coal, and Montana has an estimated 250 year supply of coal for future energy production. Montana's coal is estimated to account for one-fourth of the nation's known coal reserves. However, growing concern about greenhouse gas emissions, particularly CO₂, may limit the state's ability to utilize these reserves in a manner that promotes a vibrant economy and a healthy environment. Montana has the potential to be the supplier of coal-based energy to new markets in the United States at a premium price; however, carbon capture and storage/sequestration will almost certainly be a requirement for approval of additional coal-fired power plants as well as continued operation of existing plants. Montana, with its vast energy resources and potentially favorable sequestration opportunities, can lead the country in clean-energy development. Focused applied research is the first step along this path. Emerging technologies that indicate the economic and environmental feasibility of capturing and sequestering CO₂ within a variety of geological sinks provides Montana with a unique opportunity to capitalize on its energy resources while reducing greenhouse gas emissions.

In addition to the carbon storage/sequestration and fuel cell research, Montana's agricultural producers have the capability to supply crops necessary for the production of biofuels. Renewable energy sources including hydropower, wind power and solar power complete the list of Montana's vast energy portfolio.

At the present time, MSU-Bozeman annually directs approximately \$15 million of energy related research. The vast majority of this research is federally funded, is conducted in Montana, and involves more than 110 faculty, staff and students who work on these programs. In addition to the research and education programs based at MSU-Bozeman, we have also established a number of productive partnerships and interactions with Department of Energy (DoE) national laboratories, other US institutions as well as several international collaborations that focus on energy research and development. Summarized below is a list of the MSU-Bozeman energy programs, including research programs and partnerships with DoE national laboratories and international collaboration.

MSU-Bozeman Energy Programs:

Research Programs

- **Zero Emission Research and Technology Center (ZERT)**
This center conducts research on carbon sequestration with a basic science and engineering focus. DoE looks at this center as a primary developer of critical knowledge and technology to support the national sequestration effort. ZERT is: improving fluid flow models to predict the underground behavior of stored CO₂; measuring reaction rates of CO₂ with underground minerals under appropriate conditions; developing and testing the detection limits of new and existing CO₂ detection technologies; measuring properties of CO₂ / brine / rock systems to use in computational models; and investigating mitigation strategies for CO₂ seepage. This underpinning science will help develop understanding of best practices for storage and development of critical technology for storage verification and security.
- **Big Sky Carbon Sequestration Regional Partnership (BSCSP)**
BSCSP is one of seven DoE funded regional partnerships focusing on mitigating greenhouse gases, particularly carbon dioxide, a natural product of burning fossil fuels for energy, via storage in underground geological traps. The BSCSP has also investigated and identified large regional sources of terrestrial storage of CO₂ in soil and plants by change of land use. This program is focused on demonstration of carbon sequestration. The partnership includes the private sector, universities, DoE national laboratories and state government agencies in the region.
- **High Temperature Electrochemistry Center (HiTEC)**
HiTEC is the primary fuel cell effort at MSU-Bozeman and focuses on Solid Oxide Fuel Cell (SOFC) technology. A major focus of this research effort is identifying materials that can operate at high temperatures; are less susceptible to "poisoning" by minute amounts of sulfur; have greater fuel flexibility; and do not require expensive, precious metal catalysts. SOFCs are being targeted to

run on coal gas and may be the advanced power generation system used in FutureGen. A second major component of HiTEC is power control and power electronics including innovative work in adaptive – predictive control schemes to mitigate impact of power transients on fuel cells; investigation of efficient and inexpensive modular control systems to allow scale-up to high powers by using modular fuel cells; and multi-source power systems.

- **Montana Wind Energy Consortium**

This effort has cataloged wind resources within Montana that could assist in identifying sites for new wind projects. In addition, there is an ongoing, collaborative research effort with General Electric on the development of better quality composite wind turbine blades.

- **Coal Bed Methane Water Project**

This project investigates crops that can grow successfully in brackish waters which are produced in the process of extracting coal bed methane (CBM) thereby potentially mitigating the agricultural impact of CBM development.

- **Biofuels Project**

This project is investigating development of biofuels from oilseed crops that can be grown in Montana. There are two major approaches being pursued in this effort. One is identifying and testing technologies that allow operation of diesel engines on plant oils (not biodiesel), in a way that does not cause premature degradation of diesel engines. Diesel generators will be sited and tested in remote locations in Yellowstone National Park and may even run on waste cooking oil from MSU-Bozeman food services. The second part of this project uses plant genetic techniques to improve oil quality from crops so that refining to bio-diesel or reforming to fuels appropriate for fuel cells is more efficacious.

- **Water, Pipeline Issues**

In Coal Bed Methane development, coal mining, coal utilization for power generation, and coal-to-liquid fuel generation, there are issues of impact and utilization of water resources. The Center for Biofilm Engineering (CBE) at MSU-Bozeman has expertise in water quality and pipeline issues (both water and other materials).

Educational Programs

Global Scientists

This National Science Foundation (NSF) program annually supports four MSU-Bozeman undergraduates to perform research in Norway on carbon sequestration and global climate change projects that are in collaboration with MSU-Bozeman.

Research Experience in Carbon Sequestration (RECS)

This program brings 20-25 students at the graduate level and a few advanced undergraduates to MSU-Bozeman for a two week short course which involves field experience with carbon sequestration. Funded by DoE, this program is meant to expose top students in a variety of relevant fields to the carbon management issue. The RECS program is run by EnTech, but is hosted by MSU-Bozeman with internationally known faculty involvement.

Partnerships with DOE and DOE National Labs

MSU-Bozeman has funded partnerships with DoE's Fossil Energy Headquarters, and with the following DoE national laboratories:

- Pacific Northwest National Laboratory (PNNL)
- National Energy Technology Laboratory (NETL)
- Los Alamos National Laboratory (LANL)
- Lawrence Berkeley National Laboratory (LBNL)
- Lawrence Livermore National Laboratory (LLNL)
- Idaho National Laboratory (INL)
- National Renewable Energy Laboratory (NREL)

Partnerships with Other Universities

- Princeton University - Carbon Center
- Columbia University - Energy Center
- Stanford University - Carbon Center

International Efforts

- **Carbon Sequestration Leadership Forum**

The Carbon Sequestration Leadership Forum (CSFL) is an international group that endorses international carbon sequestration projects and leverages knowledge and capabilities in the developed world to provide knowledge, access, and education to the developing world in the sequestration field. As part of CSFL, the MSU-Bozeman ZERT program is playing a role in risk assessment. Additionally, MSU-Bozeman is heavily involved in planning and delivering an educational workshop involving decision makers from the developing world with the goal of understanding

the basics of carbon capture and storage as well as developing an idea of how to initiate a demonstration project.

- **IEA GHG Monitoring Network**
MSU-Bozeman is involved with the International Energy Agency GreenHouse Gas (IEA GHG) network and provides periodic updates on energy related research at IEAGHG international conferences.
- **International Universities**
University of Bergen, Stuttgart University, Utrecht University, University of Nottingham are partnering, collaborating, and/or sharing data with ZERT.

SUMMARY:

Because of MSU-Bozeman's involvement in the programs outlined above as well as other programs like the Collaborative Research Center (CO₂CRC) and the Solid-state Energy Conversion Alliance (SECA), we have access to a powerful network of national and international scientists and engineers from other universities, DoE national laboratories and the private sector.

At the present time, these programs are operating fairly independently. Although MSU-Bozeman has been very successful in building viable, productive, and well funded energy programs, we feel that organizing these programs under the umbrella of the MSU-Bozeman Energy Research Institute will result in a cohesive unit with even greater productivity, enhanced national and international recognition, and increased funding opportunities. The result will be an MSU-Bozeman Energy Research Institute with significantly improved capacity to address the state's and the nation's energy needs leading to enhanced economic development for Montana.