Carbon Management Canada
CMC-NCE

media release

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Alberta Innovates - Technology Futures researchers aim to transform coal power with microbes, good chemistry

Carbon Management Canada Funding Stokes Powerful Research

EDMONTON, AB (June 9, 2011) Two Alberta Innovates - Technology Futures researchers are working on cutting-edge research projects recently funded by Carbon Management Canada.

Karen Budwill is an investigator on a project led by the University of Alberta's Sushanta Mitra while Partha Sarkar is working on a project led by the U of A's Rajendar Gupta. The projects focus on two technologies to address the issue of upstream greenhouse gas emissions: microbes that convert coal into natural gas, and filters to trap carbon dioxide from power plants.

The funding organization, Carbon Management Canada (CMC), is a Network of Centres of Excellence that supports game-changing research to eliminate carbon emissions from the fossil energy industry. The recently announced decision to fund the U of A projects was made after a rigorous, international peer-review process. In the 2011 round of CMC funding, $10 million will be awarded to Canadian university researchers working on 18 projects.

Mitra's coal bioconversion project is supported by a $1.92 million grant from CMC and $150,000 from industry partner, Encana. Gupta's CO_2 capture project is supported by an $816,000 grant from CMC with an additional $100,000 per year from the Canadian Centre for Clean Coal/Carbon and Mineral Processing Technologies.

Mitra, a professor of mechanical engineering, is leading a team of 15 researchers in an ambitious project to coax communities of microorganisms to convert coal into natural gas, or methane, right in the ground. The methane produced from bioconversion could then be collected for use as a clean-burning fuel.

There are some 50 coal-fired power plants in Canada. Each emits roughly 3 million tons of carbon dioxide (CO_2) a year.

If made economically viable, the method could potentially reduce Canada's net CO_2 emissions by 25 per cent while allowing access to the energy stored in deep, unmineable coal.

"The challenge is that our understanding of the process is currently confounded by the complexity and variability of coal, the inaccessibility of many coal seams and their associated microbiota, and the lack of knowledge of basic biodegradation systematics and reactant transport in coal," explained Mitra. He and his colleagues will investigate bioconversion at the nano-scale through to lab and field scales.

Some team members will study the best environmental conditions for bioconversion and the biochemical pathways that microbes use to degrade coal. DNA analysis will identify which microbial species are at play. The researchers will also use high resolution microscopy to examine the pore structure of coal as well as the microbial-coal interface.

Mitra and other engineers on the team will design sensors to monitor microbial activity and, using lab experiments and computer modelling, will investigate how nutrients and methane flow through coal. Other contributors will create a plan for a field-scale bioconversion system.

Participating in the three-year study are investigators with the University of Alberta, the University of Calgary, Alberta Innovates – Technology Futures, the University of Western Ontario, New Paradigm Engineering Ltd. and the University of Arizona.

Steve Larter of the University of Calgary is the Scientific Director of CMC and an investigator on the coal bioconversion project. Larter noted that an interdisciplinary approach is critical to the project's success. "The problem can't be solved by a really good geochemist, or just a really good microbiologist, or just a very good engineer," said Larter. "We're trying to build an orchestra."

In another CMC-funded project, chemical and materials engineering professor Rajender Gupta is leading the charge to use good chemistry to cut CO_2 emissions from coal-burning power plants.

Gupta, along with other U of A researchers and Partha Sarkar of Alberta Innovates – Technology Futures, are looking at ways to trap the CO_2 in flue gas. The eventual goal is to direct power plant emissions through a column packed with CO_2 -trapping materials. The materials would then be "scrubbed" of CO_2 and the pure gas stored in underground reservoirs.

It is crucial to green the use of coal, explained Gupta, because our global demand for power is huge and, especially in China and India, it is on the rise. Most countries have access to coal, but not necessarily other fuels, he added. In Canada alone, each year about 50 million tons of coal are burned to generate electricity.

Specifically, Gupta's team will study the effectiveness and feasibility of using CO_2 -adsorbing amine coatings on various solid materials, such as carbon nanotubes, vermiculite, petcoke and bio-char. The best materials will have substantial surface area for adsorbing CO_2 , but won't hold on to it so tightly that it can't be cleaned off and the "filters" reused.

"This will give us a clear idea of which direction we can go," said Gupta, adding that he's particularly excited to have Alberta Innovates on board to carry out larger scale experimentation down the road. Currently, carbon capture accounts for about 70 percent of the costs of the carbon capture, transport and storage process, noted Gupta. His methods should reduce those costs.

"If (these methods) are cheap enough," said Larter, "then of course that changes the economic equation."

For a list of all 18 CMC-funded research projects visit www.cmc-nce.ca.

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