BIOENERGY WITH CARBON CAPTURE AND STORAGE (BECCS) IN THE UPPER MISSOURI RIVER BASIN

by Brad Bauer, Ben Poulter, Alisa Royem, Paul Stoy and Suzi Taylor, Montana State University

Spring 2017

Team will study how new climate change mitigation strategy might impact food, water, energy and communities

A team of scientists from **Montana State University** (MSU), the **University of Wyoming** (UW) and the **University of South Dakota** (USD) has received funding from the National Science Foundation that is bringing $6 million to these states. The team will use computer models and field experiments to study what might happen over the next 100 years if we adopt a new energy system called BECCS.

BECCS (bio-energy with carbon capture and storage), combines growing biofuel crops, like grasses and oilseeds, with carbon capture and storage. Carbon capture and storage is a technology that captures carbon dioxide (CO_2) from power plants before it enters the atmosphere and traps it deep underground.

The project will rely heavily on input from people who live and work in Montana, Wyoming and South Dakota. It could serve as a global model for how we can support businesses, farmers and communities, while protecting our water, wildlife and natural resources.

Bioenergy: the "BE" of BECCS

Bioenergy crops are plants or plant-based materials that are used for fuel or energy rather than to feed humans or animals. Bioenergy crops such as corn (currently used for ethanol), oilseeds or switchgrass are seen as fast-growing and renewable sources of energy, and a clean alternative to fossil fuels.

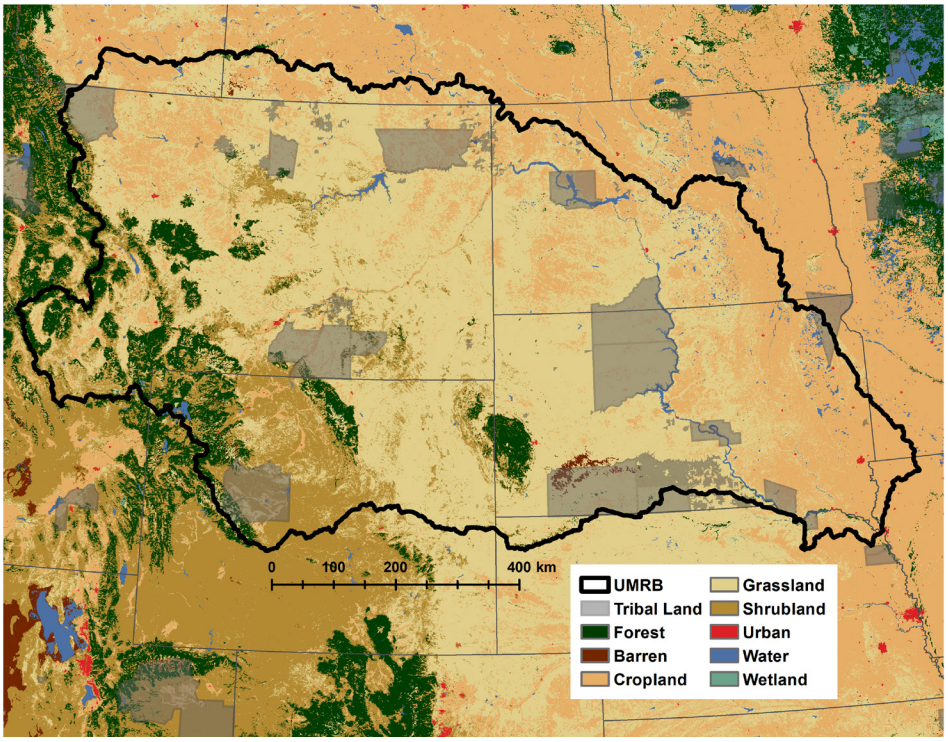
However, transferring land use from traditional crops or native vegetation to bioenergy crops might have unintended consequences, including economic effects on farmers and ranchers or habitat impacts for birds, fish and other wildlife.

Carbon Capture and Storage: The "CCS" of BECCS

Carbon capture and storage is a technology that captures the carbon that is emitted from power plants before it enters the atmosphere, compresses it into a liquid form, and traps it deep underground (also known as carbon sequestration). Carbon can be stored under the ocean bottom or in rock formations nearly a mile or more below the surface. Carbon storage is currently practiced with a high degree of success, though CO_2 can ultimately escape, and we haven't yet researched the long-term implications of carbon storage.

The project team and plan

Scientists from MSU, UW and USD will research what may occur if a large-scale BECCS approach is introduced into the Upper Missouri River Basin (UMRB), a large area of the Great Plains and northern

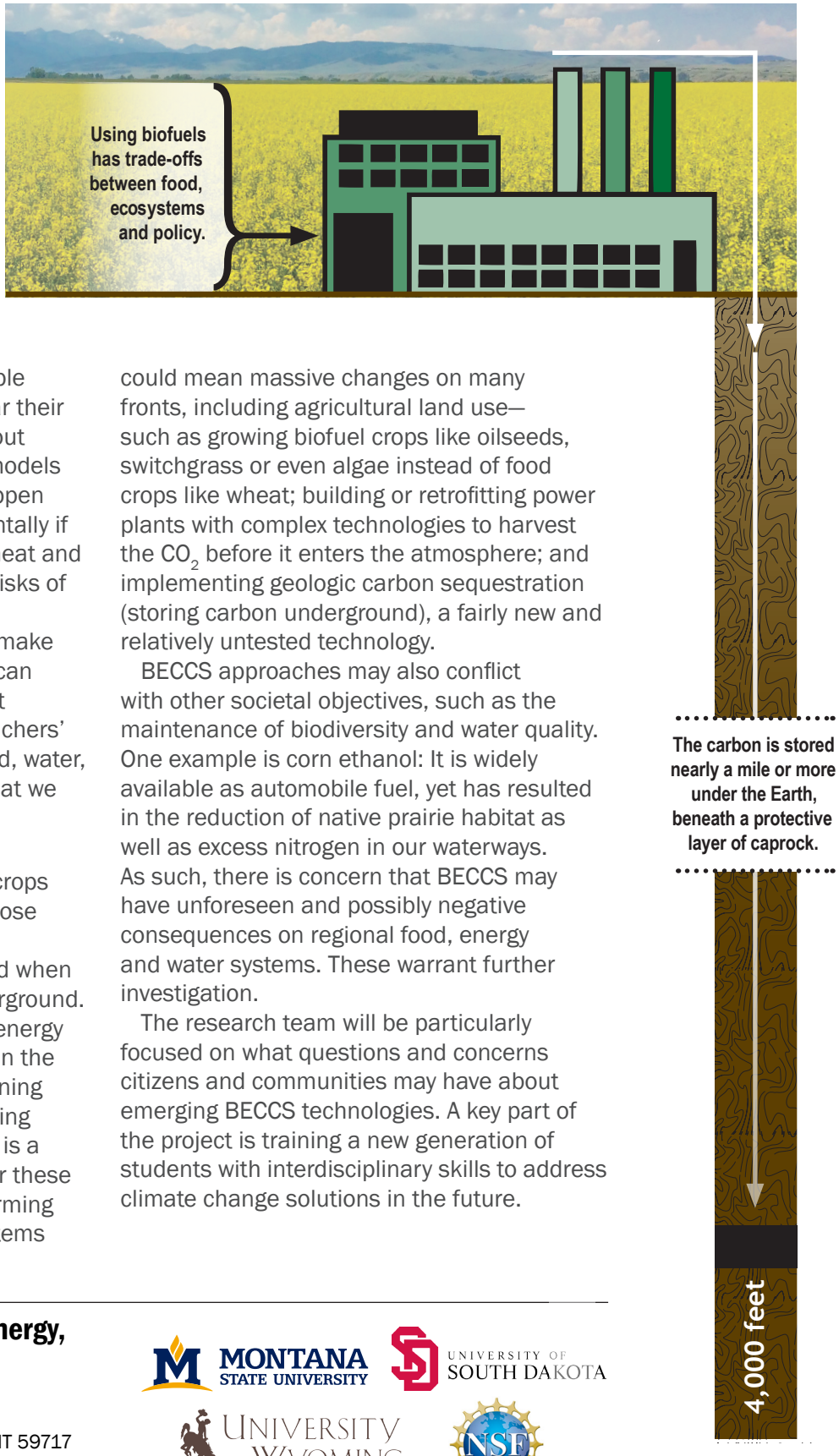


The research will focus on the Upper Missouri River Basin (UMRB), which refers to the Missouri River and all its tributaries upstream of Sioux City, Iowa. The basin contains parts or most of Montana, Wyoming, South Dakota, North Dakota and Nebraska and more than 20 Indian reservations.

This material is based on work supported by the National Science Foundation under Grant 1632810, Sustainable socio-economic, ecological, and technological scenarios for achieving global climate stabilization through negative CO2 emission policies. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Can BECCS meet our energy needs and reduce greenhouse gas emissions?

In a Bioenergy and Carbon Capture and Storage (BECCS) system, crops (such as canola, pictured here) are used for energy, and the carbon that is produced is then captured before it enters the atmosphere and stored deep underground. The result is a net decrease in carbon dioxide in the atmosphere. ILLUSTRATION NOT TO SCALE.



Rockies. The team will meet with people who live and work in the region to hear their questions, concerns and opinions about BECCS. They will also use computer models to help us understand what might happen economically, socially and environmentally if (for instance) farmers planted less wheat and more switchgrass or if the costs and risks of CCS outweigh the benefits.

Ultimately, the researchers want to make recommendations for strategies that can reduce CO_2 in the atmosphere without negatively impacting farmers' and ranchers' livelihoods and regional access to food, water, wildlife habitat and other attributes that we value.

BECCS and climate change

A BECCS systems involves growing crops that remove CO_2 from the air, using those crops as an energy source while also capturing the carbon dioxide produced when generating energy and storing it underground. CO_2 and other gases absorb infrared energy in Earth's atmosphere, which results in the greenhouse effect: critical for maintaining Earth's temperature but also the leading contributor to climate change. BECCS is a process that has the potential to lower these CO_2 concentrations. However, transforming current energy systems to BECCS systems could mean massive changes on many fronts, including agricultural land use—such as growing biofuel crops like oilseeds, switchgrass or even algae instead of food crops like wheat; building or retrofitting power plants with complex technologies to harvest the CO_2 before it enters the atmosphere; and implementing geologic carbon sequestration (storing carbon underground), a fairly new and relatively untested technology.

BECCS approaches may also conflict with other societal objectives, such as the maintenance of biodiversity and water quality. One example is corn ethanol: It is widely available as automobile fuel, yet has resulted in the reduction of native prairie habitat as well as excess nitrogen in our waterways. As such, there is concern that BECCS may have unforeseen and possibly negative consequences on regional food, energy and water systems. These warrant further investigation.

The research team will be particularly focused on what questions and concerns citizens and communities may have about emerging BECCS technologies. A key part of the project is training a new generation of students with interdisciplinary skills to address climate change solutions in the future.

Water, Agriculture, Food, Energy, Research Nexus (WAFERx)
A Montana NSF EPSCoR Track II PROJECT
Montana State University
605 Leon Johnson Hall • Bozeman, MT 59717
(406) 994-5927 • paul.stoy@montana.edu
http://waferx.montana.edu

MONTANA STATE UNIVERSITY
UNIVERSITY OF SOUTH DAKOTA
UNIVERSITY OF WYOMING
NSF