

## **Testimony before the House Environment Committee 3/7/04**

Written Testimony – Images attached as separate file.

All material available as Kansas Geological Survey Open-File Report 2004-10

Online at <http://www.kgs.ku.edu/PRS/publication/ofr2004-10/Testimony.pdf>

Chairperson Freeborn and Members of the Committee:

My name is Timothy R. Carr. I am Chief of the Energy Research Section of the Kansas Geological Survey, and Co-Director of the Energy Research Center at the University of Kansas. I do not come as an advocate of any legislation before the committee, but to provide background on green house gases (GHG) and geologic sequestration, that may have a large potential on the Kansas economy and tax base. I will attempt to place the technical, environmental and economic aspects of control of green house gas and geologic sequestration within a national, state and local perspective

Most energy used to meet human needs is derived from the combustion of fossil fuels (natural gas, oil, and coal), which releases carbon to the atmosphere, primarily as carbon dioxide (CO<sub>2</sub>). Based on the forecasts (e.g., EIA, IEA), fossil fuels will continue to be the primary source of energy for our advanced economies well into the middle of this century. While the processes are still not well understood, the atmospheric concentration of CO<sub>2</sub>, a greenhouse gas, is increasing. This raises concerns that solar heat will be trapped and the average surface temperature of the Earth will rise in response. There is the potential that CO<sub>2</sub> and other GHG's may in the future be considered pollutants. It is not within my scientific expertise or interests to argue the merits of global climate change and the need to control GHG's such as CO<sub>2</sub>. However, it is within my interests to look for environmentally and economically prudent management of our energy resources that benefits Kansas. We are working to understand carbon management within integrated energy systems. Our focus is on geologic sequestration, but within a context of providing economic access to energy for Kansas.

Sequestration encompasses all forms of carbon storage, including storage in terrestrial ecosystems, geologic formations, and oceans. Through the development of optimized

field practices and technologies, the program seeks to quantify and improve the storage capacity of all potential reservoirs.

### **Sequestration Goals**

- **Expand the number and type** of carbon sequestration opportunities in Kansas
- **Lower the cost** and optimize the value-added benefits associated with CO<sub>2</sub> storage
- **Develop field and management practices** to minimize seepage and promote permanence of storage
- **Develop capability to assess** capacity for carbon storage

There are several types of geologic formations in which CO<sub>2</sub> can be stored. These formations have provided natural storage for crude oil, natural gas, brine, and CO<sub>2</sub> over millions of years. And in more recent years, people have injected municipal and even hazardous waste for long-term storage. Each type of formation has its own mechanism for storing CO<sub>2</sub> and a resultant set of technical questions and opportunities. Many power plants and other large point sources of CO<sub>2</sub> emissions in Kansas are located near geologic formations that are amenable to CO<sub>2</sub> storage. Further, in many cases injection of CO<sub>2</sub> into a geologic formation can enhance the recovery of oil and gas, which can offset the cost of CO<sub>2</sub> capture. The major types of geologic reservoirs that are being investigated for near-term use as CO<sub>2</sub> sequestration sinks are:

- Oil and Gas Pools / Fields
- Coal Beds
- Deep Saline Aquifers
- Unconventional Reservoirs - tight gas sands; organic shales; salt domes, etc.

The use of CO<sub>2</sub> to enhance oil and gas recovery is a common industrial practice. CO<sub>2</sub> is widely acknowledged as one of the best mediums to use for enhanced oil recovery. CO<sub>2</sub> enhanced oil recovery (EOR) has been in commercial practice since the 1970s. In 2000, 34 million tons of CO<sub>2</sub> were injected underground as part of EOR operations in the United States. This is roughly equivalent to the CO<sub>2</sub> emissions from 6 million cars in one year. For EOR, 5 mcf CO<sub>2</sub> are typically ultimately stored per additional barrel oil

recovered. These injection operations take place in the southwest portion of the US using CO<sub>2</sub> produced from naturally occurring geologic reservoirs. Most of the US and Kansas does not have known large CO<sub>2</sub> reservoirs to use for enhanced recovery operations. Thus, application of CO<sub>2</sub> capture-technology and geologic sequestration could provide an affordable source of CO<sub>2</sub> for enhanced recovery operations that could provide a much-needed stimulus to the oil and gas industry. Nearly a billion barrels of oil might be producible via CO<sub>2</sub> enhanced recovery operations within Kansas. Research and development in this area will move the technology forward to make it applicable to a wider range of formations.

A novel process is the injection of CO<sub>2</sub> into coalbeds that are not minable, thus releasing the trapped methane. This process is called Enhanced Gas Recovery (EGR) or Enhanced CoalBed Methane production (ECBM), and is similar to using CO<sub>2</sub> injection to enhance production from oil reservoirs. With EGR, the injected CO<sub>2</sub> is adsorbed by the coal and stored in the pore matrix of the coal seams, releasing the trapped methane that can be sold for profit. Future work in the area can lead to the design of efficient null-greenhouse-gas-emission industrial facilities (e.g., landfills and cement kilns) and power plants that are fueled either by minable coal or by the methane released from the deep coal reservoirs. In this closed CO<sub>2</sub> process, the waste CO<sub>2</sub>, produced from the coal or methane-powered plants, is injected into the CBM reservoirs to produce more methane, and the cycle continues. A geological sink is established in the coal beds, virtually eliminating any release of CO<sub>2</sub> to the atmosphere. Coal-bed methane is the fastest growing source of US and Kansas natural gas supply. Although there are no commercial deployments of CO<sub>2</sub>-enhanced CBM recovery these is active and promising area of technology development, and eastern Kansas is uniquely situated with large industrial sources of CO<sub>2</sub> directly overlying active coalbed methane production.

Saline and depleting gas formations do not offer the value-added benefit of enhanced hydrocarbon production, but the potential CO<sub>2</sub> storage capacity of domestic saline formations is huge; estimates are on the order of several hundred years of CO<sub>2</sub> emissions. There is one commercial deployment in Norway, where one million tons of CO<sub>2</sub> per year are injected in a saline formation at the Sleipner natural gas production field in the North

Sea. Disposal of industrial waste fluids in geologic formations is a widely accepted practice; one that is a large part of the solutions that have led to cleaner surface waters in the US and worldwide. Thus, using the deep subsurface saline formations to help cleanse our biosphere is not a new concept.

The Kansas Geological Survey and the KU Energy Research Center are out in the field, in the lab and using the Internet working to better understand the potential of geologic sequestration to enhance the environmental and economic benefits of integrated energy systems to Kansas. The Russell, Kansas Integrated Energy System Project is an example of linking agriculture, energy production, and geologic sequestration to provide economic benefits while minimizing our impact on the environment. Other projects in the planning stages include using deep unminable coal beds to process landfill gas and cement kiln emissions, sequester CO<sub>2</sub> while increasing methane production. Another project that is just being organized is FutureGen. FutureGen is an attempt to build a zero emission coal-fired power plant with the next decade. A significant component of FutureGen will be geologic sequestration of CO<sub>2</sub> produced by the power plant.

We see all these projects as systems approaches to energy production that can provide environmental and economic benefits to Kansas. These projects have the potential of value-added sequestration of greenhouse gases may be as valuable as primary production in a possible carbon constrained world. Energy production has been a foundation of our Kansas economy for more than 100 years. Based on published forecasts from the International Energy Agency and the Energy Information Administration, hydrocarbons (oil, gas and coal) will remain the primary source of energy through the middle of the 21<sup>st</sup> century. Kansas has a bright energy future, and integrated energy systems can help to insure that future.