



## Kentucky Geological Survey Carbon Storage Research Incentives for Energy Independence Act 2007

The Kentucky Incentives for Energy Independence Act of 2007 mandated and funded carbon storage research at the Kentucky Geological Survey, University of Kentucky. Specific goals of this research were to:

- Quantify the potential for enhanced oil and gas recovery using carbon dioxide
- Test permanent geologic storage potential for CO<sub>2</sub> with two deep wells
- Test the Devonian shale for carbon storage potential and enhanced gas recovery
- Secure matching funds from federal and private industry to leverage State funds



KGS began this research in 2008, forming the Kentucky Consortium for Carbon Storage to attract industry partners. KGS completed the final drilling and testing program in 2013. It remains the largest state-supported carbon storage research program of which we are aware.

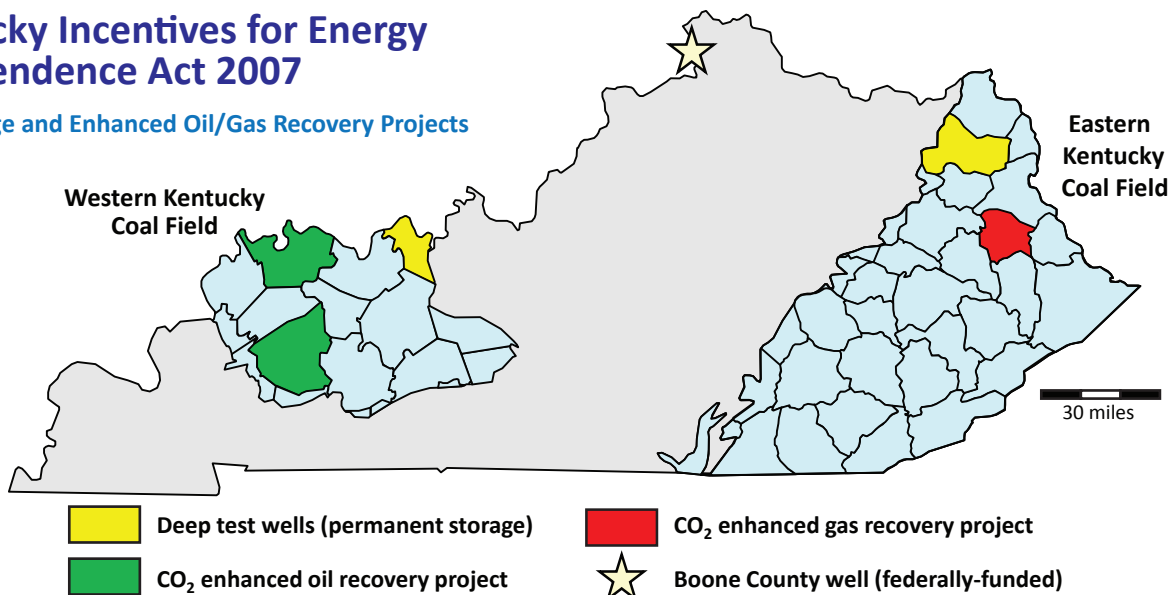
### Project Locations

The KIEIA stipulated projects be conducted in Kentucky’s coal fields. Several additional criteria guided selection of project sites to ensure results had maximum value to the commonwealth:

- Test wells near major rivers, where existing and future CO<sub>2</sub> sources will likely be located
- Target subsurface geologic formations that are broadly applicable to other areas
- Test zones at depths deep enough for efficient CO<sub>2</sub> storage, but shallow enough to minimize drilling costs, both for this program and for future commercial development
- Maximize opportunities to partner with industry and federal projects in areas of mutual interest

### Kentucky Incentives for Energy Independence Act 2007

CO<sub>2</sub> Storage and Enhanced Oil/Gas Recovery Projects



## Projects Completed

- Two new deep wells were drilled and tested for injection capacity. An 8,200-ft well in Hancock County, in the Western Kentucky Coal Field, found commercial-scale storage capacity in the Knox Group, a dolomite and sandstone formation.
- In the Eastern Kentucky Coal Field, a 4,800-ft well in Carter County proved that similar storage capacities are likely in the Knox Group in northeastern Kentucky.
- KGS also acquired advanced well logs from the Duke Energy East Bend well in Boone County, a test well drilled by a U.S. Department of Energy-funded CO<sub>2</sub> partnership.
- KGS partnered with the Midwest Geologic Sequestration Consortium to conduct a year-long CO<sub>2</sub> enhanced oil recovery project in the Sugar Creek Oil Field in Hopkins County.
- KGS and Basin Energy performed a single-well CO<sub>2</sub> injection in the Euterpe Oil Field in Henderson County. Such single well CO<sub>2</sub> projects may be useful in many of Kentucky's small oil fields.
- The Devonian black shale, Kentucky's most prolific gas-producing formation, was tested in a well in Johnson County to evaluate enhanced gas recovery and CO<sub>2</sub> storage.
- Public outreach and education were an important part of the program, using local meetings, site visits, and the KGS website to communicate plans and results.

## Matching Funds

KGS was successful in securing matching funds on most projects. Overall, the \$5 million of State funding was matched by \$8.9 million of industry and federal funds.

- Most matching funds were designated for the western Kentucky deep CO<sub>2</sub> test well because of interest in a proposed coal gasification plant in Muhlenberg County. A second phase of research at the well was funded by the U.S. Department of Energy a year later.
- KGS secured \$365,000 matching federal funds for the Devonian shale CO<sub>2</sub> injection project.
- KGS partly funded the U.S. Department of Energy Sugar Creek CO<sub>2</sub> enhanced oil recovery pilot, with a total project cost of more than \$1 million.
- KGS provided matching funds and personnel totaling more than \$500,000 for a broad range of expenses, including groundwater monitoring and road repairs.
- In addition, significant in-kind contributions, including legal assistance, risk management, geologic software, and data analyses, were provided by several companies and UK.

## Results

- Deep wells proved that there are both reservoir rocks, and overlying confining rocks at suitable depths for permanent CO<sub>2</sub> storage in eastern and western Kentucky.
- Not all of the commonwealth is suitable for permanent CO<sub>2</sub> storage but this research has reduced geologic risk in locating commercial sites.
- CO<sub>2</sub> enhanced oil recovery is a proven technology, but there are technical and economic challenges in Kentucky's oil fields.
- CO<sub>2</sub> storage in organic shales needs additional research before it is a proven technology.
- Outreach efforts indicate more education is necessary before carbon storage is widely accepted.
- Results have been documented in 28 publications and abstracts and more than 20 professional presentations. The extensive data acquired in these projects are publicly available at KGS, and will be invaluable if commercial CO<sub>2</sub> storage is mandated. See the KGS website, [www.uky.edu/kgs](http://www.uky.edu/kgs), for data and more information.