

**HB 1 Carbon Storage Research
Kentucky Consortium for Carbon Storage**

Contract PO2-855-0700011517

**Progress Report for the Quarter Ending June 30, 2008
Submitted to the Kentucky Energy and Environment Cabinet**

Kentucky Geological Survey
James C. Cobb, Director and State Geologist
University of Kentucky

David C. Harris, Principal Investigator
August 7, 2008

KYCCS.ORG



Major Accomplishments during the Quarter

- The Western Kentucky Carbon Storage Foundation was incorporated in June 2008. This 501(c)3 non-profit corporation was established to formalize the industry participation in the Western Kentucky deep CO₂ storage test. Founding members of the Foundation are Kentucky Syngas, LLC, E.ON US, and ConocoPhillips.
- A Memorandum of Agreement (MOA) between the University of Kentucky and the Western Kentucky Carbon Storage Foundation was written and executed. This agreement outlines the management and financial structure of the Western Kentucky deep CO₂ storage test. Specific project funding phases are outlined in the MOA.
- Significant progress was made on the Western Kentucky deep CO₂ storage test project. The advisory group for this project met 3 times during the quarter in Lexington, and 3 KGS staff members traveled to ConocoPhillips' office in Houston on April 11 for a well planning meeting.
- Two requests for proposals were written and posted for seismic data acquisition and project management services for the Western Kentucky deep CO₂ storage test. Proposals were reviewed and the project management award was made in early July.
- Negotiations continued with the surface land owner in Hancock County where the Western Kentucky test well will be drilled. A title search for this property was initiated, and a draft lease agreement was written. Several discussions with KGS staff were held to discuss the goals of the project and drill site options.
- A public meeting was held on April 28 in the Hancock County Fiscal Court to present the project plans and goals to the Hancock County judge executive, county magistrates, and the local residents.
- Discussions with Pike County officials continued regarding possible Devonian shale test injection wells. Brandon Nuttall met with the Pike County Judge Executive and Summit Engineering on April 30 to discuss the Burk Branch Proposal. Approaches to meeting critical data requirements were addressed. To address these critical needs, public release of data and well logs for the Rosewood #2 Bargo well (Knox County) was obtained. In addition, arrangements were made to log and acquire rotary sidewall cores from the Blue Flame K-2605 Batten and Baird well in Pike County.
- A tentative agreement to conduct a CO₂ enhanced oil recovery (EOR) pilot project in the Euterpe field in Henderson County in partnership with the Midwest Geologic Sequestration Consortium was discussed in several teleconferences. However, the proposed project was postponed indefinitely by the field operator in

late June due to a change in technical strategy for the field. We will continue to work with the operator in hopes of resurrecting the project, but are now looking for other EOR projects.

- Several options for an Eastern Kentucky deep CO₂ storage project continued to be explored. Data on the composition of the natural gas in two of the Triana Energy wells in Clark County were received for the samples taken last quarter. The samples show very low natural CO₂ levels, which is of importance if we inject CO₂ into the zones. Estimates for additional well logging and coring in the Triana wells are being obtained from the operator.
- The Triana wells in Clark County are also being considered for use in characterizing the faults that exist near the wells. In conjunction with the U.S. Dept. of Energy, we are considering the injection of perfluorocarbon tracers into the wells, followed by surface monitoring around nearby fault locations to detect any perfluorocarbon leakage. This will indicate if the faults are sealed or leaky, and will help to assess the risk of CO₂ leakage along similar faults in structurally-complex areas.
- An existing well in Bell County (eastern Kentucky) was offered to the Consortium for collection of additional data and possible deepening to the Knox Group for CO₂ injection tests. Cost estimates are being obtained for the proposed work.
- Dave Harris gave a presentation on the overall KYCCS program at the Platt's Carbon Capture and Sequestration Conference in Houston on June 26. Rick Bowersox presented a paper on the Western Kentucky deep CO₂ storage project at the North-Central Geological Society of America meeting in Evansville on April 25.

Details of activity during the quarter pertaining to each of the subprojects follow.

Western Kentucky Deep CO₂ Storage

Lead Geologists:

Rick Bowersox and Dave Williams

KYCCS-WKY – Summary of 2nd Quarter 2008 Activities

Advisory Committee Meetings Highlights:

1. Rick Bowersox, Dave Williams, and Dave Harris met with ConocoPhillips technical staff at the ConocoPhillips offices in Houston, Texas, on April 11 to discuss the proposed seismic program, well design, coring, logging, and testing programs
2. April 29, Lexington Core Library: The proposed working relationships between KGS, industry partners' foundation, and project manager were presented by Dave

- Harris and agreed to by the advisory committee.
3. May 22, Lexington Core Library: Neeraj Gupta of Battelle Memorial Institute made a presentation of their project management capabilities. Well design, site construction, and injection testing planning is continuing at ConocoPhillips.
 4. June 19, Lexington Core Library: Discussion largely focused on administrative issues including organization; RFP's for seismic acquisition and project management; and well siting, design, and permitting.

Project Administration:

1. KGS and ConocoPhillips representatives met with landowners Marvin and Brenda Blan at their home in Hancock County on several occasions to present the project, discuss terms for access to their property, and wellsite construction issues.
2. Requested and received bids in May for a Phase 1 environmental survey of the Blan's property to be completed following execution of a property use agreement, anticipated early in the 3rd quarter. The bid was awarded to GeoScience Consultants, Inc., of Georgetown, Kentucky, with the survey to commence in the 3rd quarter.
3. Initiated the title search of the Blan property in mid-May, however as of July 11 the attorney had not yet completed this. Anticipated completion is on or before July 18.
4. Received a proposal and cost quote from Marty Parris in June for soil gases monitoring on the Blan property to commence in the 3rd Quarter.
5. The Western Kentucky Carbon Storage Foundation, and 501(c)3 corporation, was organized and incorporated in June by ConocoPhillips, Kentucky Syngas, LLC, and E.ON US for the purpose of providing funding for the project.
6. The Memorandum of Agreement between KGS and the Foundation was executed in June.
7. RFP UK-0771-8, Seismic Acquisition, was opened for proposals by vendors in May. One proposal totaling ~\$998k was received and this RFP was closed without award in June.
8. RFP UK-0775-8, Project Management, was opened for proposals in June. Contract awarded on July 2.
9. RFP UK-0777-9, Seismic Acquisition (revised), was opened for proposals in June.
10. Potential partners contacted during the 2nd quarter included the Illinois Department of Commerce and Economic Opportunity (DCEO), Office of Coal Development, Duke Energy, ICON Construction, EEI, Cash Creek, TVA, and EPRI. Small contributions to the project are expected from TVA and EPRI. A grant application for \$250k will be prepared for submittal to Illinois DCEO.

Presentations:

1. Technical reviews of regional and wellsite geology were presented at each of the advisory committee meetings and the meeting at ConocoPhillips' offices.
2. Rick Bowersox presented a paper on April 25 at the North-Central GSA meeting, Evansville, Indiana, *Solving the Carbon Storage Puzzle in Kentucky*. The abstract for this presentation is attached.

3. Reviewed project status in a presentation for Dr Len Peters and UK administration representatives on May 13.
4. Rick Bowersox presented a review of the project at the KGS Annual Seminar, May 23, *Western Kentucky Deep Saline Reservoir CO₂ Storage Test*.

1. SOLVING THE CARBON STORAGE PUZZLE IN KENTUCKY

[BOWERSOX, J. Richard](#)¹, WILLIAMS, David A.², GREB, Stephen F.¹, NUTTALL, Brandon C.¹, PARRIS, T. Martin¹, ANDERSON, Warren A.¹, DRAHOVZAL, James A.¹, and HARRIS, David C.¹, (1) Kentucky Geological Survey, University of Kentucky, 228 Mining and Mineral Resources Building, Lexington, KY 40506-0107, j.r.bowersox@uky.edu, (2) Kentucky Geological Survey, University of Kentucky, P.O. Box 653, Henderson, KY 42419

Anticipating requirements to mitigate CO₂ emissions from the coal use in Kentucky, and to provide incentives for the development of coal-to-synthetic fuels facilities in the commonwealth, the Kentucky legislature passed House Bill 1 in a 2007 special session. HB 1 authorized funding for three mandated research projects by the Kentucky Geological Survey: deep CO₂ storage test wells in the Western and Eastern Kentucky Coal Fields and tests of CO₂ enhanced oil and gas recovery (EOR/EGR) including the CO₂ storage capacity of Devonian black shales. To accomplish these mandates the KGS has formed the Kentucky Consortium for Carbon Storage with industry participants. The challenge of the deep storage tests is to demonstrate CO₂ storage in diverse reservoirs with a limited number of test wells. Subsurface pressure, temperature, and water salinity suggest CO₂ storage in reservoirs 2500-8000 ft deep. The Cambrian Mt. Simon Sandstone is an attractive CO₂ storage reservoir over much of the Midwest, but its limited geographic extent, depth, and uncertain reservoir properties due to its diagenetic history may limit its utility for CO₂ storage in Kentucky. Cambrian sandstones in the Conasauga Group and Rome Formation in the Rome Trough of eastern Kentucky have excellent reservoir properties but were deposited in fault-bounded grabens. The sealing integrity of these faults is not well known and needs further research before the CO₂ storage potential of these deep sandstone reservoirs can be assessed. Waste injection wells in Kentucky are completed in the thick Cambrian-Ordovician Knox Group carbonates, where favorable reservoirs may be found at shallower depths. However, the Knox section has highly variable and laterally discontinuous porous and permeable intervals; thus these dense carbonates may serve as both reservoir and seal. Other strata in Kentucky with CO₂ storage potential warranting further reservoir characterization are the Ordovician St. Peter Sandstone and High Bridge Group carbonates. Significant potential exists in Kentucky for CO₂ EOR/EGR production. The consortium will demonstrate the effectiveness of CO₂ in miscible and immiscible EOR projects in conventional petroleum reservoirs, and test the feasibility of using CO₂ to displace methane in the organic-rich Devonian Ohio Shale in eastern Kentucky.

[North-Central Section - 42nd Annual Meeting \(24–25 April 2008\)](#)

[General Information for this Meeting](#) Session No. 32

[Carbon Dioxide Sequestration](#)

Casino Aztar Conference Center: Walnut C

1:10 PM-5:00 PM, Friday, 25 April 2008

Geological Society of America *Abstracts with Programs*, Vol. 40, No. 5, p. 82

Agendas, meeting summaries, and other details of the western project's activity can be found in the Appendix and on the project web site (www.kyccs.org).

**Kentucky Consortium for Carbon Storage
Western Kentucky Deep Saline Project Industry Partners**

Funding Partners

ConocoPhillips
E.ON U.S. LLC
Kentucky Syngas, LLC
Kentucky Geological Survey, University of Kentucky
Kentucky Governor's Office of Energy Policy
Smith Management Group
State of Illinois Office of Coal Development
Schlumberger Carbon Services

Associate Partners

Big Rivers Electric Corp.
GEO Consultants, LLC
Henderson County Riverport Authority
ICON Construction, Inc.
Praxair Inc.
Sunshine Oil and Gas
University of Kentucky Center for Applied Energy Research
URS Corp.

Pending Participation

Tennessee Valley Authority
Duke Energy

Eastern Kentucky Deep CO₂ Storage

Lead Geologists:

Steve Greb and Warren Anderson

Triana Energy has drilled 3 deep wells in Clark County; Kentucky to a depth of about 4,000 feet. The geology of these wells meets the general criteria for a test of deep CO₂ sequestration potential. Discussions continued with Triana personnel concerning use of the wells in this research. Geochemical analyses of gas samples taken in March were received and indicate very low amounts of CO₂ in the 2 wells. The gas contains high levels of nitrogen and anomalous concentrations of helium, both of which have been observed in other wells in the area. These gas compositions will not prevent use of the wells in our research, but is important to know before injection starts. Characterization work is continuing on these wells, and costs estimates for logging are being obtained.

Marty Parris discussed the use of chemical tracers added to the injected CO₂ with colleagues at the U.S. Dept. of Energy. These tracers might help to indicate if faults near the Triana Energy wells are sealing or transmissive. By injecting CO₂ with tracers into the wells and collecting soil gas samples near the fault locations, any leakage could be positively identified as the injected gas. Marty is continuing to coordinate this research direction with U.S DOE.

The Pine Mountain Regional Development Authority has offered the group a well in Bell County, that could be deepened to the Knox for injection tests.. Other deep drill sites have been offered in Johnson and Pike Counties. These sites are continuing to be evaluated. We hope to hold a second meeting for project partners in the 3rd quarter.

Potential partners in the eastern deep CO₂ storage project include:

Interstate Natural Gas/Crossrock Drilling
Pikeville, KY

Triana Energy
Charleston, WV

Pike County Energy Advisory Board
Pikeville, KY

E.ON US
Louisville, KY

Pine Mountain Regional Development Authority

Chesapeake Energy (pending)
Charleston, WV

Schlumberger Carbon Services
Houston, TX

CO₂ Enhanced Oil and Gas Recovery

Lead Geologists:

Brandon Nuttall and Marty Parris

Devonian Shale CO₂ Enhanced Natural Gas Recovery and Storage Project

- Met with Pike County Judge Executive and Summit Engineering to discuss Burk Branch Proposal. Approaches to meeting critical data requirements were addressed. (30-Apr-2008)
- Received notification that a Pike County shale gas well, the Blue Flame K-2605 Batten & Baird, permit 102566, was scheduled to be drilled and that access could be arranged for logging and coring to satisfy some of the data requirements for the Burk Branch Proposal. Supervised acquisition of logs and cores for the Blue Flame K-2605 Batten & Baird well. (30-Jun-2008).
- Updated software and license agreement for Comet3 dual-porosity/dual-permeability reservoir simulation software to be used in simulation and design of CO₂ injection project.
- Contacted Schlumberger Carbon Services (logging and coring services) for price quotes for open-hole logging suite (lithodensity, temperature, audio, array induction, etc), elemental capture spectroscopy (shale characterization and analysis), and rotary sidewall coring (core analysis). Established logging and coring program specifications and obtained commitments for matching funds (Battelle, \$28,245 estimated) and cost share (Schlumberger, \$63,008 estimated). KYCCS direct cost is \$28,341 (estimated). Cost estimates are pending final invoice for actual services.
- Secured public release of log, core, and analytical data for the Rosewood #2 Bargo, permit 99456, Knox County. (25-Jun-2008)
- Contacted Omni Labs (Weatherford) for cost estimates on laboratory services for shale core analysis. Working on identifying required analyses.

CO₂ Enhanced Oil Recovery Project

Discussions continued with Bernie Miller (Miller Energy Technology) and Scott Frailey (Illinois State Geological Survey) regarding a joint CO₂ EOR project in the Euterpe Field in Henderson County, KY. Planning for this project was abruptly halted in late June when the field operator decided against implementing a CO₂ flood. We are hopeful this project can be resurrected in the future. We are continuing to look for partners interested in conducting a CO₂ EOR project in their field, but interest has been low to date.

Partners and potential partners for the EGR and EOR projects include:

Interstate Natural Gas/Crossrock Drilling
Pikeville, KY

Chesapeake Energy
Charleston, WV

Journey Oil
Houston, TX

Pike County Energy Advisory Board
Pikeville, KY

Perry County Coal (TECO)

Hard Rock Drilling Co.

Travell Energy
Bowling Green, KY

Summitt Engineering: well site services

Midwest Regional Carbon Sequestration Partnership (Battelle): “piggyback” logging contribution

Miller Energy Technology
Lexington, KY

Appendix

Western Deep CO₂ Storage Project

Meeting Proceedings April –June, 2008

Western Kentucky CCS Well Planning Meeting Houston – April 11, 2008 Meeting Notes

Topics for Discussion:

- 1) 2D Seismic Acquisition Program
- 2) Coring and Core Analysis Program
- 3) Logging Program
- 4) Well Testing & Dynamic Logs
- 5) Drilling Location / Spud Date / Permitting
- 6) Well Design
- 7) Monitoring Program
- 8) Well Planning & Execution Responsibilities

Action Items are summarized at the end of the notes.

2D Seismic Acquisition Program

The 26-mile 2D seismic acquisition program proposed by KGS at the March 27th meeting was reviewed and generally approved, with minor modifications suggested (below). The acquisition parameters suggested by Ron Sfara (COP) were reviewed.

A modification to Line D was suggested. Where the road turns west mid-way along the line, it was suggested to continue straight south to run closer to the drilling location. The feasibility of this route will be explored with potential seismic contractors. (Harris, KGS)

A target date of May 1 was set for an RFQ for seismic acquisition and processing to potential contractors. (Harris, KGS)

Coring and Core Analysis Program

Chip Feazel (COP) reviewed initial findings from his core analysis work. Porosity development is evident in the Dupont, Wainscott and Blakemore cores. It is primarily vuggy porosity and solution-enhanced fracturing in the fabric-destructive dolomite and associated with the Appalachian orogeny.

The coring program was modified from the conceptual program developed in January. The conceptual program was 5 coring runs of 60 ft each, with 2 rotary sidewall core runs. The agreed coring program is as follows:

New Albany Shale:	30' whole core or rotary sidewall cores (whichever is lower cost)
Maquoketa Shale:	30' whole core
Trenton/Black River Carbonates:	30-60' whole core
St. Peter/Knox Transition:	30' whole core
Knox formation:	3 runs of 120' whole core (low case 3 runs of 60')
Mt. Simon:	Rotary sidewall cores if present

4" whole core is desired to capture the potentially large vugs in the Knox.

The core analysis program was not discussed – but an action item to refine the core analysis program was delegated to Paul Johnson (COP).

Logging Program

Shallow section (0-~400 ft):

CBL if required by regulations.

Additional logs as desired by R&B, at R&B's cost.

Surface section (~400 - ~3000 ft), prior to drilling production section:

Cased hole gamma ray

Surface section (~400 - ~3000 ft), after drilling production section:

Gamma ray

Neutron

Quadropole Sonic

Cement bond log (quadropole sonic may provide CBL)

Production section (~400 - ~8000 ft):

Platform Express (GR, Caliper, Neutron, Density)

Quadropole and Shear Sonic

Formation Micro Imager (FMI)

The group decided to delete the ECS log and check shots from the conceptual program. Michelle Pittenger (COP) will check on whether check shots will be required. NMR, Spectral GR and MDT were discussed and rejected.

The logging program will involve 3 runs:

- 1) PEX, Sonic, CBL (2 passes with Sonic)
- 2) FMI
- 3) Rotary SWC (see above)

Bidding out the logging program was also discussed. Bids would likely be evaluated on cost, quality and technology.

Collecting a brine sample was discussed. It was decided that this may be possible during the drilling operation. If not, a slickline bailer may be used.

Testing Program

Carlos Gonzalez (COP) introduced a proposed testing approach using resettable openhole packers available from World Oil Tools. This will involve placing two inflatable packers a set distance apart and pumping fluids into the target formation interval between the packers. Injection quantities will be sized to target a 6-8 hour injection period per interval followed by an 18-24 hour falloff. The packer spacing will be selected to minimize the number of trips out of the hole to adjust the spacing.

The testing program will plan for the following tests:

Mt. Simon:	1 test (brine), if present
Knox:	5 tests (brine), 1 test (CO ₂ , high injectivity interval)
St. Peter	1 test (brine)

The brine injection tests will be sized for around 1500 bbl, and the CO₂ injection test for 300 tons. The CO₂ volume is roughly equivalent to 3500 barrels.

One of the Knox tests will include a step rate test to determine formation parting pressure.

A final, full interval test will be performed to help determine total well potential. A 5-point test was suggested.

The group agreed to this program.

Drilling Location / Spud Date / Permitting

The drilling location within Blan Farm was discussed. The proposed location is too near the farmer's house and several alternatives were suggested.

Update 04/16: The location has been moved to the north part of the farm in the trees.

Location issues to consider:

- Potential for H₂S / Safety
- Noise
- Traffic (minimize impact to farmer)
- Sinkholes/karst on property
- Road access – dirt or gravel – farmer expects gravel
- Location wetness (winter drilling)
- Fence in drillsite (Update 04/16: farmer wants electric fence for cattle)
- Location access for non-operational personnel
- Road weight limits (general & winter drilling)

Spud date was discussed. “Winter drilling” covers the period from November to April, and Mr. Blan had been opposed to winter drilling on his farm. The group suggested that this was a non-starter, since it would be challenging to spud by October; and May 2009 is too late. Update 04/16: Mr. Blan has agreed to winter drilling.

Permitting was also discussed, though more discussion is needed (Apr. 29th meeting?) Obtaining the EPA injection permit may be a critical path item, so this needs to be pursued as soon as possible.

A lease agreement between KGS and Mr. Blan is needed. Chris Dodson (COP) is preparing a draft agreement for circulation week of April 14th.

Well Design

Paul Heard circulated an updated well design. The design would set surface casing below potable water (+/- 400') and production casing near the base of the Trenton/Black River carbonates (+/- 3000'). Production hole would be 7-7/8" and would be left uncased.

Paul Heard (COP) will continue to work on the well design based on the coring, logging and testing program needs. Potential for downsizing to 6-1/4" production hole will be explored in terms of viability and cost savings. The limiting factor may be the desire for 4" whole core.

Monitoring

This topic was not discussed. It has been discussed in broad terms in past meetings; perhaps specifics can be presented in Apr. 29th meeting?

Responsibilities

Paul Heard (COP) prepared and distributed a proposed responsibility framework for execution of the program. Generally, responsibility would be split between KGS and COP with specific tasks assigned to each. KGS and COP would be free to engage 3rd parties to aid with specific portions of their responsibility.

KGS would have responsibility for Regulatory, Permitting, Land Acquisition, Seismic Program, Geologic Planning, and Geologic Reporting.

COP would have responsibility for Well Planning, Well Execution and Non-Geologic Reporting.

Paul also raised some questions about the practical mechanics around money flows, contracting, HSE, etc. that need to be addressed separately (Apr. 29th meeting?).

Action Items

Rennie / Williams / Smith – Prepare lease with landowner ASAP (Draft for circulation week of Apr. 14th).

Williams – Collect proposals for environmental survey (and propose contractor selection at Apr. 29th meeting?)

Parrish – Prepare and execute baseline monitoring program (can this be presented at Apr. 29th meeting?)

Cobb – Prepare and execute shallow seismic program.

Bowersox – Revise seismic Line D as proposed in the meeting.

Harris / Bowersox – Prepare seismic RFQ by May 1.

Harris / Heard – Review contractor proposals submitted prior to Apr. 15th (Sandia, Texas World, others) by Apr. 29th and report to group on Apr. 29th.

Harris / Pittenger – Prepare formation tops including uncertainty range for well planning (by Apr. 29th?)

Pittenger – Confirm whether checkshots will be required.

Johnson / Bowersox – Review and refine core analysis program, involving appropriate experts.

Heard – Progress well planning including location visit (end April?), discussions with contractors, etc.

KYCCS – Western Kentucky
April 29, 2008, Lexington

Agenda

5. Welcome and introductions – Dave Williams
6. Changes at GOEP – Sarah Smith
7. MOA and 501(c)3 status – Dianna Tickner
8. Wellsite leases – Sarah Smith
 1. Blau farm lease
 2. GEO Consultants lease
 3. title due diligence
9. Project management – Dave Harris
 1. plan
 2. consultant quotes
10. Seismic program
 1. RFP status – Dave Harris
 2. Line 7 reprocessing – Michelle Pittinger
11. Site Characterization
 1. Preliminary environmental assessment – Dave Williams
 1. bids status/evaluation
 2. timing
 2. Shallow seismic program – Dave Harris
 3. Baseline monitoring – Dave Harris
12. Well design and testing – Scott Rennie
13. Permitting – Dave Williams
14. Additional partners status
 1. Illinois Office of Coal Development Proposal – Dave Harris
 2. Duke Energy: Gibson County, Indiana, Mt. Simon wells – Dave Harris
 3. TVA – Rick Bowersox
15. KGS Annual meeting, May 23: Dave Harris
16. Recap and action items

**WESTERN KENTUCKY SEQUESTRATION SUB-PROJECT
MEETING**

April 29, 2007

KGS Well Sample and Core Library, Lexington, KY

These people were present for the fourth meeting of this sub-project group:

KGS Staff

Dave Williams
Dave Harris
Jim Drahovzal
Rick Bowersox
Jim Cobb
John Kiefer
Mike Lynch

ConocoPhillips

Scott Rennie
Paul Heard

Smith Management Group

Sara Smith
Karen Thompson

E.ON US

Roger Medina
Doug Schetzel

Geo Consultants

Jeff Douthitt

Schlumberger

Dwight Peters

UK CAER

Jim Hower

ECSI

Charlie Reeves

Welcome and Introductions

Dave Williams called the meeting to order at 10:00 a.m. After discussing upcoming events at KGS in the next month, the group agreed to meet again on the afternoon of May 22, eventually deciding to meet at a conference room at CAER because it is next to the KGS Well Sample and Core Library. The meeting will be after a meeting of the KGS Advisory Board the same morning.

Dave Williams summarized the previous evening's visit with the Hancock County Fiscal Court and a few citizens of the county on the project plans. He said there were good questions from both the magistrates and the general public.

Changes at GOEP

Sara Smith explained the changes at the state's office for energy policy: Talina Mathews is no longer head of the office. The agency is part of a reorganization which will create a state cabinet for energy and environmental issues, headed by Dr. Len Peters, who is well known to UK, KGS and CAER. Essentially all energy-industry related issues will be reorganized into this cabinet. She noted that Dr. Peters went to the Hancock Fiscal Court meeting the previous evening and has shown much interest in and understanding of this topic and project. John Kiefer called Dr. Peters someone who's great to work with and easy to talk to.

Sara Smith noted that Hancock Fiscal Court the previous evening also agreed to issue revenue bonds to assist ICON Construction with a project in the county which may benefit from the data gathered during this deep-storage project. There was discussion of contacting ICON again to join the project.

Wellsite leases

She also said ConocoPhillips has provided sample lease documents for the property owner, which have been sent to UK's legal office for approval. She added she will contact the Hancock County attorney to seek a title search of the property.

MOA and 501(c)3 status

On the issue of the Foundation / 501(c)3 status, Scott Rennie indicated a conference call would be scheduled for the following week to try to finalize the formation of the Foundation.

Project Management

Dave Harris discussed quotes he received on project management, including the following:

Sandia: \$486,000
Battelle: \$540 – 760,000
Texas World Operations: \$664,890
Laurel Oil & Gas: (Hourly rate sheet)

Dave noted that Laurel Oil & Gas would most likely work only as a subcontractor on certain tasks for a larger contractor with more project management capabilities. He also listed seven project-management issues to be overseen:

- Project management
- Well design
- Permitting
- Procurement
- Field supervision
- Reservoir evaluation
- Final report / evaluation

Scott Rennie said these figures should be seen as only ranges and estimates, not final bids or quotes. The participants also discussed how to deal with add-on increments to costs. Dave Harris said he would be meeting in the afternoon with the UK purchasing office about the process of getting quotes or bids and making payments to contractors for the project.

Participants also discussed the capabilities and experience of each of the companies which has submitted quote estimates as well as the length of time expected for completing the permit application process. It was noted that Illinois has found the federal permitting process to have been particularly time-consuming for a similar project.

Participants discussed a proposed project management and responsibility model from ConocoPhillips. After discussion about how to address request to see or tour the project site and who should oversee access, recommendations were agreed to about how it should be modified in those areas.

Participants also discussed which of the partners should handle particular contracts for services and how the Foundation can maintain its tax-exempt status and avoid the appearance of any impropriety even if some paid work is performed by its members. This will be resolved during the industrial partners' next conference call.

Dave Harris presented a model of the relationships of the partners and the division of responsibilities at this point in project planning. (See model, **Relationship of Partners and Division of Responsibilities**, at the end of this document.)

It was agreed that, at the project site, ConocoPhillips' health and safety rules will be observed.

There was a discussion of extracting as much data as possible from the deep hole since it will be an expensive project conducted only once, and any data gathered will be valuable for a variety of purposes. The partnership will need to deal with any incremental additional costs for extra data gathered.

Seismic Program

Dave Harris said that the Houston meeting of April 11 resulted in some changes to the seismic program, but it will still involve about 25 miles of line. He will send the information to three companies to get quotes on conducting the seismic program.

Scott Rennie indicated the re-processing of Line 7 has been submitted to be done, and the data should be completed in late May at a cost of about \$10,000.

Site Characterization

Dave Williams said he had contacted five contractors about preliminary environmental site evaluations and received quotes ranging from \$1400 to \$3600. He will take a closer look at the information and the quotes.

Rick Bowersox showed a topographic map with the existing oil and gas wells as well as the planned deep well, explaining that the new site is further from the property owner's home and will reduce the noise and dust in the vicinity of the home.

Dave Williams showed an aerial photo of the site pointing out land features, and Paul Heard showed photos from a walk-through of the site the previous day, noting features including roads, fences, gates, etc.

Jim Cobb said he will assign Ed Woolery to do the shallow seismic work as soon as the UK academic year ends and Ed will be able to spend time in the field.

Dave Williams reported that baseline monitoring work (soil-gas sampling and water sampling) will be done by KGS staff. Karen Thompson suggested that a summary of the monitoring work to be done be provided to partnership members.

Well Design and testing

Scott Rennie summarized the results of the April 11 Houston meeting to develop the well design, coring, logging, and testing. (See draft document, **Western Kentucky CCS Well Planning Meeting**, at end of this document.) Paul Heard will work from the well design developed at the Houston meeting to estimate the cost of the well.

Permitting

Dave Williams said work to get the drilling permit from the state Division of Oil & Gas will begin as soon as the lease with the property owner is signed. It should not be a significant problem. The work to get a federal EPA permit will need to be contracted out as soon as possible. Both of these will be KGS responsibilities.

Additional Partner Status

Various participants will contact TVA, Duke, Cash Creek and EEI about becoming partners in the project.

ACTION ITEMS:

KGS / Jim Drahovzal

Contact ICON Construction again about joining this partnership in light of its plans for a project near to the deep-hole site. Re-contact Duke Energy about joining as well.

KGS / Rick Bowersox

Will contact TVA about joining the partnership, though an answer won't come before the end of June

KGS / Dave Williams

Evaluate proposals for preliminary site environmental assessment

Sara Smith

Contact Cash Creek about joining the partnership

Contact Hancock County attorney to request a title search of the site property and refer the attorney to KGS for follow up.

Kentucky Syngas, LLC / Dianna Tickner

Contact EEI about joining the partnership

ConocoPhillips / Scott Rennie & Paul Heard

Convene a conference call of the industrial participants to finalize the formation of the 501(c)3 and Foundation.

Finalize the well design, coring, logging, and testing plan and develop cost estimate

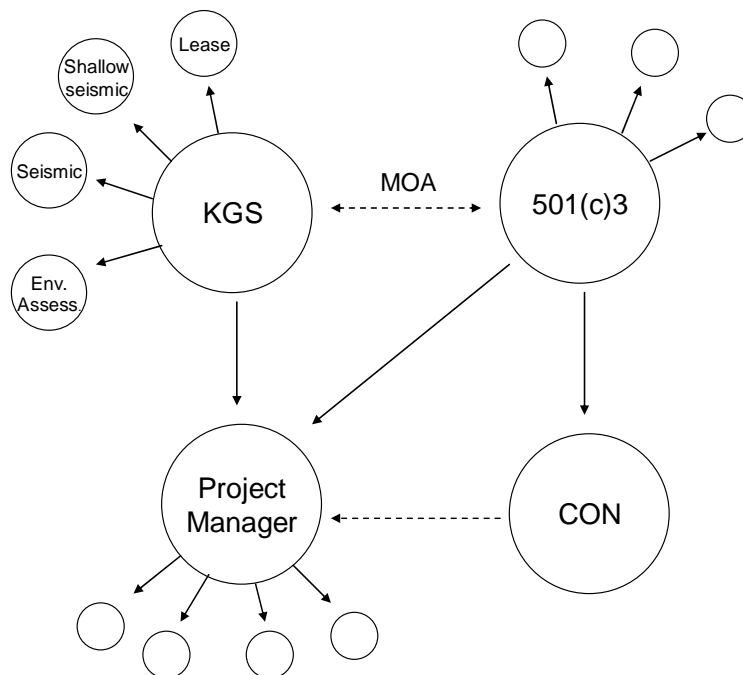
Modify the project management model to reflect that KGS will oversee the communication of information about what is happening at the project site as well as oversee access to the site by all but those working there

KGS

Send Ed Woolery to the proposed site at the end of the UK academic year to do the shallow seismic work

Do background monitoring of soil-gas activity and water sampling; provide a summary of the work to be done to the partnership members.

Begin search for a contractor to conduct the EPA permitting process in May 08



RELATIONSHIPS OF PARTNERS AND DIVISION OF RESPONSIBILITIES

(Dashed lines indicate oversight; solid lines indicate payment for services)

**KYCCS – Western Kentucky Project Planning Meeting
KGS Lexington Core Library, May 22, 2008**

Agenda

1. Welcome and introductions – Dave Williams
2. Status of agreements:
 - A) 501(c)3 Foundation
 - B) MOA
 - C) ROW and Injection
 - D) Data Sharing
3. Status of bids for services:
 - A) Title search – Dave Williams
 - B) Phase 1 environmental survey – Dave Williams
 - C) Seismic program – Dave Harris
 - D) Project Manager – Dave Harris
4. Contacts with prospective project partners:
 - A) ICON Construction – Jim Drahovzal
 - B) TVA – deferred until June
 - C) Cash Creek – Sara Smith
 - D) EEI – Dianna Tickner
5. Drilling project status:
 - A) Shallow seismic survey –
 - B) Baseline monitoring – Dave Harris
 - C) Well design and testing program – Scott Rennie
 - D) Wellsite construction – Paul Heard
 - E) Permitting – Dave Williams
6. KGS Annual Meeting May 23, Lexington Core Library – Dave Harris
7. Recap and action items

**KYCCS – Western Kentucky Project Meeting
May 22, 2008
KGS Well Sample and Core Library, Lexington**

These people were present for the meeting of this sub-project group:

KGS Staff	ConocoPhillips	E.ON	US
Jim Cobb		Scott Rennie	Roger Medina
John Kiefer		Paul Heard	
Dave Harris		Michelle Pittenger via teleconference	
Dave Williams			
Rick Bowersox		Schlumberger	Smith Management
Jim Drahovzal		Dwight Peters	Karen Thompson
GEO Consultants		Wyatt, Tarrant, & Combs	Battelle
Jeff Douthitt		Troy Nichols	Nareej Gupta
Ross	Miller	Phil Jaguki	

Welcome and Introductions

Dave Williams called the meeting to order at 9 AM, welcoming members and guests Nareej Gupta and Phil Jaguki of the Battelle Memorial Institute, Columbus, Ohio.

Status of Agreements

Troy Nichols of Wyatt, Tarrant & Combs discussed the status of the 501(c)3 Foundation agreement. Scott Rennie and Roger Medina noted that there are pending minor changes in the document however the goal is to have the agreement executed by May 30 with Diana Tickner, Peabody Energy, nominated as the Foundation president. Scott Rennie and Jim Cobb stated that the MOA should also be ready for execution by May 30 pending minor changes expected from UK's legal department. Dave Harris reviewed four the MOA exhibits: Exhibit 1, Scope of Work; Exhibit 2, Project Schedule; Exhibit 3, Project Phase Funding Points; and Exhibit 4, Project Funding Structure. Execution of the Data Sharing Agreement with R&B Resources and the ROW and Injection Agreement with the landowner will follow the 501(c)3 and MOA in early June. Phases 1 and 2 of the project are completed and an initial funding request of \$550k will be forthcoming for Phase 3. Dave Harris noted that an expected contribution by the Illinois Geological Survey of \$250k will be made through the Foundation. Paul Heard stated that he will request in his next meeting with the landowner that the location of the test well as currently proposed be moved to save construction expense.

Contacts with Prospective Project Partners

Jim Drahovzal reported that ICON Construction had withdrawn from the Skillman Bottom site negotiations and is pursuing a site near Lewisport. Their participation in our project is still uncertain. Rick Bowersox reported that participation by TVA was still possible but will not be resolved before the end of June. However Roger Medina noted that their focus is shifting from

fossil fuels to nuclear power plants. Dave Williams reported that Cash Creek will not be participating in our project and Rick Bowersox had received an email from Diana Tickner that EEI will likewise not be participating.

Status of Bids for Services

Dave Williams reported that the title search was underway and bids for the Phase 1 environmental assessment had been reviewed. Bids were requested from six companies and three were complete and acceptable. Mr Williams recommended that the proposal for the environmental assessment by GeoScience Consultants be accepted and the project board concurred. Jeff Douthitt observed that permitting the test well is a critical-path activity. Nareej Gupta of Battelle stated that EPA permitting of both brine and CO₂ injection tests cannot be avoided but the permitting process should take less than six months. Dave Harris reported that the RFP for the seismic acquisition program had been completed and was available on the UK Purchasing Division website (www.uky.edu/Purchasing). Proposals by vendors are due on June 10 with the contract expected to be awarded by June 24. Four companies have been solicited to submit proposals: Appalachian Geophysical, Precision Geophysical, Western-GECO, and SSI. It was suggested by a representative of Battelle that Great Lakes Geophysical should be contacted.

Dave Harris is preparing the RFP for the project manager with input from Paul Heard. Nareej Gupta made a short presentation outlining Battelle's qualifications and experience managing CO₂ storage tests. Battelle has operated a project manager with complex contracts for the Ohio Stratigraphic Test, Mountaineer, and East Bend Projects as well as the proposed Michigan test. Battelle has worked collaboratively with the EPA in outlining project goals and procedures. Battelle's experience includes permitting at both state and Federal levels, contract negotiation, materials acquisitions, and services. Battelle personnel are on-site during operations working with a contractor that oversees project operations. Battelle is a non-profit 501(c)3 corporation providing research and development consulting and laboratory management among other services.

Drilling Project Status

The shallow seismic program across the proposed and alternative well sites is anticipated to be 4-6 lines and should be initiated by mid-June. Likewise, the baseline surface soil gas monitoring program should be underway at about the same time according to Dave Harris. Paul Heard made a presentation about his visit to the proposed wellsite with a drilling contractor to determine construction requirements and well testing (attached). As presently conceived, road and drillsite construction would exceed \$200k thus Mr Heard will discuss moving the wellsite to another, less costly location with the landowner. Upon execution of the agreement with the landowner, the drillsite will be surveyed and a plat prepared for KY DOG permitting. Dave Williams noted that drillsite construction could be delayed to comply with closure for the Indiana Bat hibernating season [September 1-April 30; USFWS, April 2007, Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision, p. 121; see also Federal Register, v. 72, no. 43, p. 9913-9917, March 6, 2007]. Rick Bowersox distributed a map detailing wells of all types surrounding the proposed drillsite as well as a map of shallow geologic in the vicinity of the wellsite (attached). Mr Bowersox observed that there is a possibility of making a shallow (< 600 ft drill depth) hydrocarbon discovery with our proposed test well.

KGS Annual Seminar, May 23

Dave Harris invited the project advisory board to the KGS Annual Seminar on Friday, May 23, at which presentations would be made about the KYCCS projects.

Recap and Action Items

1. All documents should be executed by mid-June
2. Action items – responsible party:
 - a) Completion of title search – Dave Williams
 - b) Final drillsite location – Paul Heard
 - c) Drillsite location plat – Dave Williams
 - d) Shallow seismic program and background soil gas survey (including summary of soil gas monitoring procedure and goals) – Dave Harris
 - e) RFP for project manager – Dave Harris
 - f) Phase 3 funding proposal by the end of June – Dave Harris
 - g) Initiate permitting – Dave Williams
3. Next meeting: TBA, during the week of June 16 at the KGS Lexington Core Library.

**KYCCS – Western Kentucky Project Planning Meeting
KGS Lexington Core Library, June 19, 2008**

Agenda

1. Welcome and introductions – Dave Williams
2. Status of agreements:
 - A) MOA – Dave Harris
 - B) ROW and Injection
 - C) Data Sharing
3. Contacts with prospective project partners:
 - A) TVA – Dave Harris
4. Status of bids for services:
 - A) Title search – Dave Williams
 - B) Phase 1 environmental survey – Dave Williams
 - C) Seismic program RFP – Dave Harris
 - D) Project Manager RFP – Dave Harris
5. Drilling project status:
 - A) Drillsite location – Dave Williams
 - B) Shallow seismic survey – Ed Woolery
 - C) Baseline monitoring – Dave Harris
 - D) Well design and testing program – Scott Rennie
 - E) Wellsite construction – Paul Heard
 - F) Permitting – Dave Williams
 - G) Phase 3 funding proposal – Dave Harris
6. Recap and action items
7. General announcements
 - A) The Energy and Environment Cabinet became effective June 16, 2008, Dr. Leonard K. Peters, Secretary. The former functions of GOEP are now a part of this cabinet.
 - B) The Western Kentucky Carbon Storage Foundation, Inc. was formed effective June, 2008.
 - C) Kentucky Oil and Gas Association (www.kyoilgas.org) annual meeting June 30-July 2, Louisville
8. Next meeting

**WESTERN KENTUCKY SEQUESTRATION SUB-PROJECT
MEETING
June 19, 2008**

KGS Well Sample and Core Library, Lexington, KY

These people were present for the fourth meeting of this sub-project group:

KGS Staff

Dave Williams
Dave Harris
Rick Bowersox
Jim Cobb
Mike Lynch
Donna Webb

ConocoPhillips

Scott Rennie
Paul Heard (via phone)
Michelle Pittenger
Sarah Edman

Peabody Energy

Dianna Tickner

E.ON US

Roger Medina
Sharon Dodson

UK CAER

Jim Hower

Welcome and Introductions

Dave Williams welcomed participants and asked each to introduce himself or herself to the group.

There was some discussion of the continuing efforts to attract more partners to the project, including TVA, which apparently will make a small donation, and EPRE, among others.

Dave Harris announced that the Memorandum of Agreement between KGS/UK and the Foundation has been signed and its approval complete. The university is now reviewing the lease agreements with the property owner for access to the site and associated costs and with R & B for right of way onto the mineral-rights they have leased and to grant them access to all data gathered in the project.

Dave Williams said he is still discussing the new site location on the property with its owner, who has asked for an additional \$15,000 lease for the pasture land which will be used. He has also asked that a dam which creates a pond on his property be repaired, at a cost of about \$2,500. There was discussion of the possibility of seeking another property owner in the vicinity, which could delay the start of the work. Dave will continue discussions with the owner, possibly offering some additional money, if necessary.

Jim Cobb said he is still planning to ask the state of Indiana to contribute to the project, as Illinois coal development office has. And Dave Harris added that the partners are still waiting for an answer from Duke Energy about participation and possible access to data from Duke's Gibson well in the region.

Dave Williams reported that he's having trouble getting the title attorney to provide him the results of the title search. He told the group that Geosciences, Inc., of Georgetown, Ky. has received the contract to do the Phase 1 environmental assessment of the project site.

On the seismic program RFP, Dave Harris said only one proposal came in by the original deadline. It was from Dawson Geophysical for nearly \$1 million, well above the anticipated cost. A representative of Appalachian Geophysical indicated it never received the RFP, though the company is interested. The one proposal was rejected, the seismic program revised and it has been re-advertised through UK. It was suggested that all potential vendors be contacted after the RFP is issued to insure they receive it. There are probably about six vendors who would be interested in submitting proposals.

Rick Bowersox explained the revisions to the program, saying there was a reduction of the off-road segments and routes through forested areas. This should help reduce cost proposals by at least a third. The new deadline for proposals is July 3.

Dave Harris said an RFP for a project management company closed yesterday. He hopes to see the proposals soon and form a committee to make a selection. He expects up to three proposals.

Dave also said he asked Marty Parris of KGS to develop a proposal for soil gas monitoring of the site before and after drilling and injection. He handed out the proposal which has a cost of \$11,800. There was discussion of whether atmospheric issues, such as changes in weather, could have a serious impact on background soil-gas readings and should be monitored as well. But it was also pointed out that Marty Parris' sampling analyzes the isotopic differences between samples of gas taken at a site, because natural forms of the gasses and the forms injected are of different isotopes. It was agreed that the soil gas sampling is something which needs to be done. Dave Harris said he has included the cost in the project's total expense.

Rick Bowersox made a presentation on porosity development in the Knox formation, followed by a discussion of the public perception of what happens to carbon dioxide injected into the deep geology.

Paul Heard discussed the well design, construction and testing program. A graphic of the cores which will be taken in the well was handed out. Paul also noted that moving the site from the original location on a hill to a pasture below it could save \$50,000 or more.

On permitting issues, Dave Williams said that it should take the Kentucky Division of Oil and Gas about two weeks to approve an application. He explained what information must be submitted and the bonding requirements. So far, he added, the project is still on target for a February 1, 2009 spud date.

There was a discussion about gathering all the necessary data for a U.S. EPA permit application and the timeline for the application.

Dave Harris handed out a funding proposal with line items for the various costs in Phase 3 and how they will be divided between KGS and the Foundation. They may need adjusting when the seismic data acquisition proposals come in. Because "property damage" payments will be made to the property owner only after the damage is done, those costs will be moved to Phase 4.

There was a discussion of the need to do water well monitoring during the project and how much of it needs to be done.

Jim Cobb made several announcements: Rick Bowersox will be making a presentation on this project at the annual meeting of the Kentucky Oil and Gas Association. He (Cobb) and Dave Harris will be updating state legislators on June 20 about the status of the projects funded by House Bill 1 money.

The next meeting will be on July 24th, 9:00 a.m. at the Well Sample and Core Library.

ACTION ITEMS:

Dave Williams

Finalize the agreements with the property owner.

Get a title opinion from the title attorney (with help from Sara Smith) and, when completed, follow up with the oil and gas permit submission, Phase I environmental assessment and site survey

Check on the breadth of the right of way associated with the Marathon pipeline on the site property

Check on the possibility that a storm water runoff permit is needed for the project

Foundation partners / KGS

Finalize the news release announcing formation of the Foundation and issue it to the news media.

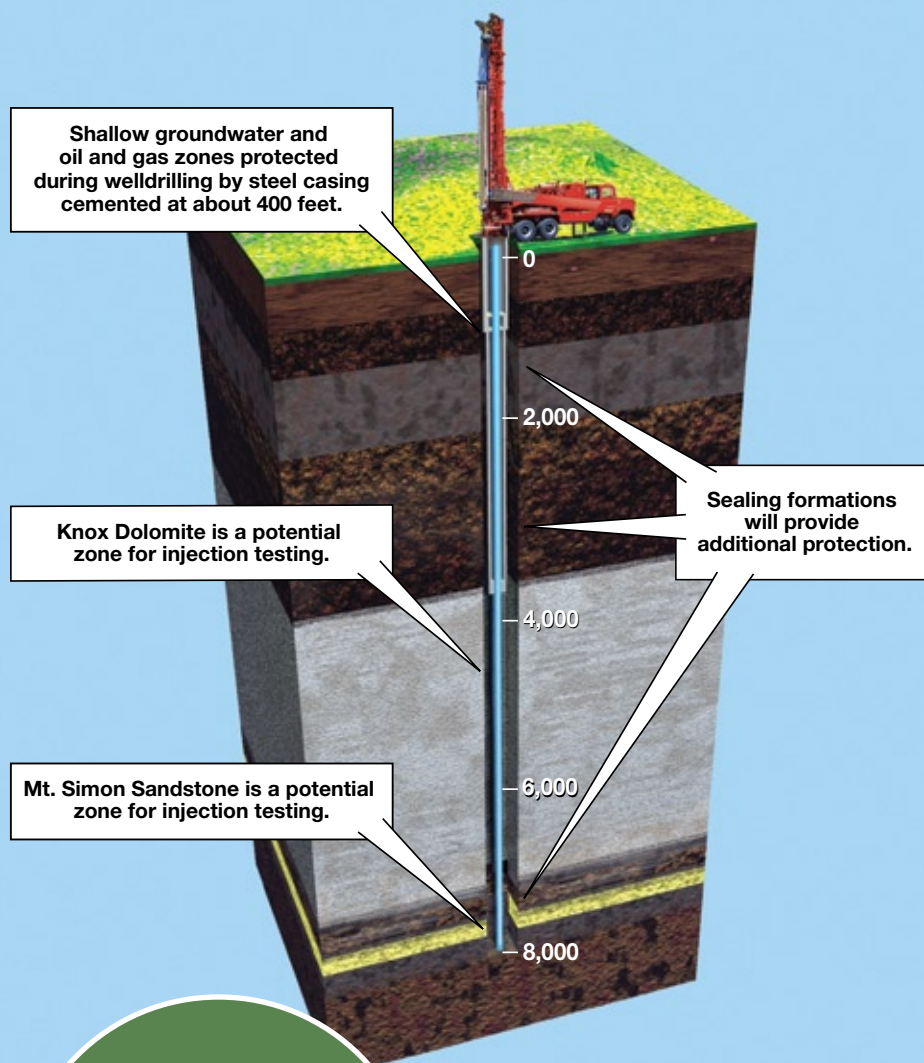
Foundation partners

Choose an accounting firm and a bank for accounts

Scott Rennie and Dianna Tickner will work on the application for funding from the Illinois Office of Coal Development

Scott Rennie and Sara Smith will talk to Duke Energy representatives about joining the Foundation and about the availability of data from the Gibson well.

Carbon Dioxide Injection Well



Data Sheet



What is the purpose of the well test?

This carbon dioxide (CO₂) well will be drilled as part of a research project to better understand the geology for deep carbon storage in Western Kentucky, an important step in understanding the costs and technical issues associated with carbon management.

Who is doing this project?

The project will be undertaken by the Kentucky Geological Survey (KGS) and the Western Kentucky Carbon Storage Foundation (Foundation). The research program will be managed by KGS, which is part of the University of Kentucky, with technical support from the Foundation. Peabody, ConocoPhillips and E.ON U.S. are members of the Foundation and will fund most of the project.

What will the project accomplish?

We are evaluating the feasibility of deep carbon storage in Western Kentucky. The project will contribute to the knowledge being gained by other carbon storage projects in the Midwest and around the United States. It also will help answer questions about the feasibility and economics of storing CO₂ produced by commercial-scale projects.





Commonwealth of Kentucky
Office of the Governor

FOR IMMEDIATE RELEASE

Contact: Dick Brown
502-564-2611

**Governor Beshear Announces Public-Private Partnership to
Test Geology for Carbon Storage**

*Peabody Energy, ConocoPhillips, E.ON U.S. will work with Kentucky Geological Survey
on Carbon Storage Research*

FRANKFORT, Ky. (June 30, 2008) – Gov. Steve Beshear today announced that the state is partnering with the newly created Western Kentucky Carbon Storage Foundation to advance the science of long-term carbon storage opportunities in the commonwealth.

Peabody Energy, ConocoPhillips and E.ON U.S. formed the non-profit Foundation to work with the Kentucky Geological Survey in a project that includes drilling a well to test the Knox and Mount Simon geological formations at a site in Hancock County.

“The importance of carbon dioxide sequestration research for our state’s and the nation’s energy future cannot be overstated,” said Gov. Beshear. “Kentucky has been a strong supporter of efforts to develop partnerships and projects such as this one, and the results from this testing are crucial in our quest to develop and implement clean coal technologies and become a world leader in energy production.”

The Geological Survey, based at the University of Kentucky, will lead project research in conjunction with other state agencies. The Foundation will provide technical assistance along with the majority of project funding. An agreement on a well site is expected to be signed within several weeks.

“Proving the feasibility of carbon storage in deep saline reservoirs is important for Kentucky’s future,” said Jim Cobb, State Geologist and Director of the Geological Survey. “The Kentucky General Assembly made this test possible through passage of the 2007 energy bill. We are happy to be working with the Foundation and our industry partners whose participation is vital to the success of this research.”

The test is responsive to Kentucky’s legislative mandate calling for research on Kentucky’s carbon storage potential. It includes drilling a well and injecting a small amount of carbon dioxide into formations as much as 8,300 feet below the surface and will analyze the suitability of long-term geologic storage.

Drilling is anticipated to occur this winter, with the carbon dioxide injection test in spring 2009. The project will also include significant monitoring by the Geological Survey.

“This project brings together a diverse energy team with a common goal of advancing the science of carbon capture and storage,” said Dianna Tickner, Chair of the Western Kentucky Carbon Storage Foundation and Peabody’s Vice President of Generation and Btu Conversion. “The information and knowledge gained from this research will benefit both the commonwealth and the entire nation.”

Peabody and ConocoPhillips are progressing with a joint feasibility study for a large, commercial scale coal gasification project that would produce substitute natural gas. The plant would be fueled by a new coal mine to be located in western Kentucky. An analysis of multiple long-term carbon dioxide solutions is part of the feasibility study.

Peabody Energy is the world’s largest private-sector coal company, with 2007 sales of 238 million tons and \$4.6 billion in revenues. Its coal products fuel approximately 10 percent of all U.S. electricity generation and 2 percent of worldwide electricity.

ConocoPhillips is an integrated energy company with interests around the world. Headquartered in Houston, Texas, the company has approximately 32,800 employees and \$183 billion of assets.

E.ON U.S. is a subsidiary of E.ON A.G., the world's largest investor-owned energy services provider. E.ON US owns and operates Louisville Gas and Electric Company, a regulated utility that serves 318,000 natural gas and 390,000 electric customers in Louisville and 16 surrounding counties, and Kentucky Utilities Company, a regulated electric utility in Lexington that serves 518,000 customers in 77 Kentucky counties and five counties in Virginia.

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