



## Coal-Seq Consortium- Phase III Proposal

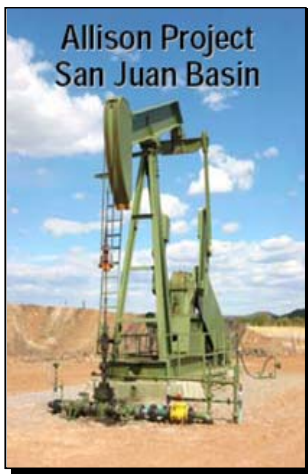
### Consortium Objectives

To advance industry's understanding of complex coalbed methane and gas shale reservoir behavior in the presence of multi-component gases via laboratory experiments, theoretical model development and field validation studies such that primary recovery, enhanced recovery and CO<sub>2</sub> sequestration operations can be commercially enhanced and/or economically deployed.

### Phase I - Accomplishments

The Coal-Seq project was initially launched in 2000 as a U.S. DOE-funded investigation into CO<sub>2</sub> sequestration in deep, unmineable coalseams. Phase I accomplished a number of important objectives, which included:

- Performed detailed studies of the Allison Unit CO<sub>2</sub>-ECBM pilot and the Tiffany N<sub>2</sub>-ECBM pilots in the San Juan basin.
- Created a field "best practices" manual based on the experience gained from those pilots.
- Performed study on geochemical reactions when injecting CO<sub>2</sub> into San Juan basin coal.
- Evaluated the applicability of commonly used isotherm models when applied to multi-component gaseous systems.
- Developed an improved model for predicting permeability changes in coal with CO<sub>2</sub> injection.
- Collected coal samples from most coal basins in the U.S. and created the first publicly- available database of CH<sub>4</sub>,



- N<sub>2</sub> and CO<sub>2</sub> isotherms for these basins.
- Participated in the design of the RECOPL CO<sub>2</sub>-ECBM/sequestration project in Poland.
- Assessed the CO<sub>2</sub> sequestration and concomitant ECBM recovery potential of coal basins in the U.S.
- Developed a model for screening potential CO<sub>2</sub>-ECBM/sequestration projects.
- Performed a technical and economic sensitivity study of CO<sub>2</sub> sequestration in coal.
- Facilitated global technology exchange and networking via the [www.coal-seq.com](http://www.coal-seq.com) website and annual Coal-Seq forums.

### Phase II - Accomplishments

The results from Phase I have been documented in a series of reports which are publicly available ([www.coal-seq.com](http://www.coal-seq.com)). An important outcome of the project was that serious limitations in our knowledge of reservoir behavior when CO<sub>2</sub> is injected into coal were uncovered. To address these limitations, the project was extended in 2005 as a government-industry collaborative consortium. While the detailed results from the consortium are proprietary, selected accomplishments from this phase included:

- An improved multi-component isotherm model to estimate sorption capacity for coalbed gases based on readily accessible coal characterization parameters.
- Identification of a more appropriate multi-component counter-diffusion model.
- Laboratory setup, procedural development and experimental calibration for new EOS development.
- Laboratory setup for constant-strain core-flood experiments.
- Measurement of excess stress in coal when CO<sub>2</sub> is injected and identification of significant coal mechanical weakening when exposed to CO<sub>2</sub>.
- Comparative study of geo-mechanical and permeability models for CBM operations.
- Reservoir analysis of the RECOPL (Poland) and Yubari (Japan) CO<sub>2</sub>-sequestration pilots.
- Assessment of "best" reservoir environments and development strategies for CO<sub>2</sub>-ECBM/sequestration projects.
- Development of an internet-accessible knowledge base.



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- Continued the facilitation of global technology exchange and networking via the [www.coal-seq.com](http://www.coal-seq.com) website and annual Coal-Seq forums.



- Laboratory experiments to understand how coal compressibility factors, as utilized in the various permeability models, vary with pressure and/or gas concentration.
- Technical and economic feasibility assessments of CO<sub>2</sub>/N<sub>2</sub> – ECBM/sequestration in major worldwide coal basins (e.g., San Juan, Powder River, Western Canadian, Surat, Ordos, Kuznets, etc.).
- Begin to examine the potential of organic shales to sequester CO<sub>2</sub> by collecting core and measuring CH<sub>4</sub>, CO<sub>2</sub> and N<sub>2</sub> isotherms in most gas shale basins across the U.S.
- Provide a regular tele-forum for members and various project performers to exchange findings and ideas; also create a web-based discussion board.
- Continue the facilitation of global technology exchange and networking via the [www.coal-seq.com](http://www.coal-seq.com) website and annual Coal-Seq forums.

### Membership

Current participants in the consortium include:

- U.S. DOE/NETL
- BP America
- CO<sub>2</sub>-Cooperative Research Centre
- ConocoPhillips
- Illinois Clean Coal Institute
- Japan Coal Energy Center
- Repsol YPF
- Schlumberger
- Shell International Exploration & Production

### Phase III - Objectives

Further continuation of the consortium is currently being considered. Building upon the findings from Phase 2, some of the topics that have been identified for investigation in Phase 3 include:

- Completion of the EOS work undertaken in the current project, and extension to full CH<sub>4</sub>-CO<sub>2</sub>-N<sub>2</sub> ternary gaseous systems with moisture.
- Development of a robust model to account rigorously for water as a separate adsorbed component.
- Laboratory validation of the multi-component, bi-directional diffusion model.
- Laboratory experiments to understand the conditions and nature of coal weakening and/or mechanical failure with CO<sub>2</sub> injection.

### Proposed Contractors

- Advanced Resources International (program management, field studies, reservoir modeling, technology transfer)
- Higgs-Palmer Technologies (geomechanical and permeability modeling).
- Oklahoma State University (equation-of-state model development, sorption model development)
- Southern Illinois University (core flood experiments)
- TBD (diffusion model validation)

### Phase III Terms

- 3 – year duration.
- \$25,000 per year per member.
- 50% discount on previous work for new members.
- 10 industry sponsors required.
- Expressions of interest sought by June 30, 2008.
- Target launch 3rd quarter 2008.

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