



Advanced Resources  
International, Inc.

December 2011

# Advanced Resources International QUARTERLY UPDATE

*Unconventional Resources • Enhanced Recovery • Carbon Sequestration*

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Advanced Resources International (ARI) is a professional services firm that provides geological, reservoir engineering, business and policy analysis and advice on a global basis related to unconventional gas resources, enhanced oil recovery and geologic carbon sequestration. Our quarterly update highlights current industry trends, ongoing and completed projects, recent publications, upcoming workshops and events, and company news. We encourage you to visit our website at [www.adv-res.com](http://www.adv-res.com) to learn more about our company history, research and technology activities, industry news and much more. You may also contact our offices listed at the bottom of this page for additional information.



## AN UPDATED REVIEW OF U.S. AND WORLDWIDE CO<sub>2</sub>-EOR RESOURCES

Tyler Van Leeuwen, Project Manager at Advanced Resources International, Inc. (ARI), gave a presentation at the 17th Annual CO<sub>2</sub> Flooding conference in Midland, Texas on December 8th entitled, "An Updated Review of U.S. and Worldwide CO<sub>2</sub>-EOR Resources". This presentation provided an overview of recent work Advanced Resources has performed assessing the technically and economically recoverable oil resource available through "Next Generation" CO<sub>2</sub>-EOR technology in the United States and selected International basins. In addition to assessing the technology's potential for use in domestic, onshore reservoirs, ARI has begun to assess the ability of CO<sub>2</sub>-EOR to mobilize oil contained in the Residual Oil Zones below existing oil fields and in large, hydrodynamic fairways in areas of West Texas. In his presentation, Mr. Van Leeuwen shared with the audience that the technically recoverable CO<sub>2</sub>-EOR resources in domestic oil reservoirs and the ROZ to be on the order of 176 Billion barrels, with an implied CO<sub>2</sub> demand of 62 billion metric tons. Mr. Van Leeuwen then discussed the viability of the existing coal-fired power plant fleet to provide such large volumes of CO<sub>2</sub> to the EOR market. He finds that sufficient CO<sub>2</sub> supplies could be provided to the market if 90% capture was achieved on at least 2/3rd of the power plant fleet and regional pipelines were built to link areas of high CO<sub>2</sub> emissions, such as the Ohio River Valley and the Southeast, with areas of high CO<sub>2</sub>-EOR potential but limited CO<sub>2</sub> supply, such as the Permian Basin, Mid-Continent, and Rockies. Finally, Mr. Van Leeuwen discussed the economic benefits that would accrue from developing these domestic CO<sub>2</sub>-EOR resources, which amount to almost \$ 7 trillion in the form of state and local taxes, increased markets for services, and payments for CO<sub>2</sub> supplies.

[www.adv-res.com/pdf/Van\\_Leeuwen\\_Midland\\_Presentation.pdf](http://www.adv-res.com/pdf/Van_Leeuwen_Midland_Presentation.pdf)



## CCUS -- IS IT SOMETHING OLD, AND/OR SOMETHING NEW?

Michael Godec, Vice President of Advanced Resources International, Inc. (ARI), gave a presentation at the 9th Annual EOR Carbon Management Workshop in Houston, Texas on December 5, 2011, entitled, "CCUS -- Is it Something Old, and/or Something New?" This presentation challenges the so-called newly recognized concept of Carbon Capture, Utilization, and Storage (CCUS), especially as it pertains to the application of enhanced oil recovery (EOR), as replacing the traditional concept of CCS (or just Carbon Capture and Storage). In the presentation, Mr. Godec notes that participants in this conference have always recognized the value proposition offered by CCUS -- the utilization of CO<sub>2</sub> for CO<sub>2</sub>-EOR as a pathway to CCS. Nonetheless, he observes that too many participants in the "CCS space," this

seems to be a new revelation. He goes on to describe what it means for those who have always believed in the CCUS paradigm. In this regard, the presentation described ARI's perspectives on the size of the U.S. and global CO<sub>2</sub>-EOR/CO<sub>2</sub> storage target, the volume of potential oil production that could result from CO<sub>2</sub>-EOR in the U.S., who will most benefit from this production, what changes can help more rapid CCUS deployment, and what can slow it down.

[www.hartco2.com/Conference-Agenda/](http://www.hartco2.com/Conference-Agenda/)



#### **CO<sub>2</sub> INJECTION PERFORMANCE IN THE FRUITLAND COAL FAIRWAY, SAN JUAN BASIN: RESULTS OF A FIELD PILOT - SPE 127073-PP**

This SPE paper was selected to be peer reviewed and published in the SPE Journal Volume 16, Number 4, December 2011, pp. 864-879. This work was based on the Pump Canyon CO<sub>2</sub>-enhanced coalbed methane (ECBM)/sequestration demonstration in New Mexico, which had the primary objective of demonstrating the feasibility of CO<sub>2</sub> sequestration in deep, unmineable coal seams through a small-scale geologic sequestration pilot. At the project site, a new CO<sub>2</sub>-injection well was drilled within an existing pattern of coalbed-methane-production wells. Primarily operated by ConocoPhillips, these wells produce from the Late Cretaceous Fruitland coals. CO<sub>2</sub> injection into these coal seams was initiated in late July 2008 and ceased in August 2009. A variety of monitoring, verification, and accounting (MVA) methods were employed to track the movement of the CO<sub>2</sub> in order to determine the occurrence of leakage. A detailed study of the overlying Kirtland shale was also conducted to investigate the integrity of this primary caprock. This information was used to develop a detailed geologic characterization and reservoir model that has been used to further understand the behavior of this reservoir.

This paper describes the project, covering the regulatory process and injection-well construction, the different techniques used to monitor for CO<sub>2</sub> leakage, and the results of the modeling work.

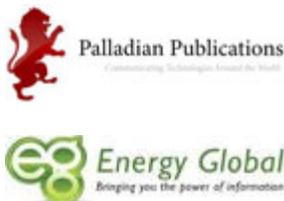
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#### **INTERNATIONAL CASE STUDIES: THE SHALE GAS REVOLUTION GOES GLOBAL**

In early November 2011, Vello Kuuskraa, President of Advanced Resources International, attended the World Shale Gas Conference and Exhibition sponsored in part by the International Gas Union and the American Gas Association. Mr. Kuuskraa participated in the session "International Case Studies: The Shale Gas Revolution Goes Global", providing his presentation entitled, "Overview of Global Shale Gas Resources and Sustainable Development". The conference, held in Houston, Texas, was well attended by representatives from the domestic and international energy industry.

[www.worldshalegas.org/](http://www.worldshalegas.org/)



#### **LIVING UP TO THE PROMISE?**

In November, 2011, Steven M. Carpenter, George J. Koperna, Jr., and David Riestenberg of Advanced Resources International Inc., wrote an article which discusses the potential of CO<sub>2</sub>-enhanced coalbed methane recovery (CO<sub>2</sub>-ECBM). The paper was published in the journal *CBM Review*.

The article describes the potential for coal reservoirs to produce not only incremental methane via secondary recovery processes (CO<sub>2</sub> and/or N<sub>2</sub>

## CBM REVIEW

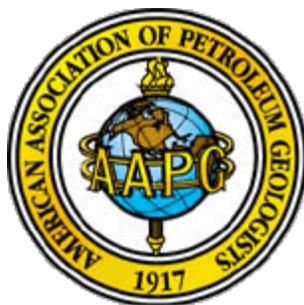
injection), but also to act as long-term, safe and reliable storage targets for greenhouse gases (GHGs). Results of field research efforts conducted by both public and private entities to date are discussed in the article. While these field tests do provide initial insights into the long-term viability of CO<sub>2</sub>-ECBM and sequestration in coalbeds, it is clear that there is much more to learn. Challenges to large-scale deployment of CO<sub>2</sub>-ECBM are discussed in the article, notably the loss of injectivity over time due to coal swelling. For example, the need for a large number of injection wells and/or low injection rates may mean that ECBM plays a smaller, more supportive role in carbon capture utilization and storage than initially hoped. Longer-term storage tests, combined with advanced post-injection monitoring are recommended to evaluate the suitability of deep coal beds to safely trap and store CO<sub>2</sub> and to understand other critical issues such as the potential for coal weakening due to CO<sub>2</sub> injection.

[www.energyglobal.com/documents/ARI-online.pdf?dm\\_i=RE6,MH0M,4K9XQP,1TJ9Y,1](http://www.energyglobal.com/documents/ARI-online.pdf?dm_i=RE6,MH0M,4K9XQP,1TJ9Y,1)



### OUTLOOK FOR CMM IN MEXICO AND COLOMBIA

Jonathan Kelafant, Sr. Vice President of Advanced Resources International, attended the 2011 U.S. Coal Mine Methane Conference, sponsored by the U.S. Environmental Protection Agency's Coalbed Methane Outreach Program (CMOP). Mr. Kelafant's presentation, entitled, "Outlook for CMM in Mexico and Colombia", summarized his recent participation in a definitional mission for U.S. Trade and Development Agency. The conference was held in Park City, Utah on October 18 through 20, 2011.



### ENHANCED GAS RECOVERY AND CO<sub>2</sub> STORAGE IN COAL BED METHANE RESERVOIRS: OPTIMIZED INJECTED GAS COMPOSITION FOR MATURE BASINS OF VARIOUS COAL RANK - SPE 139723-PP

Karine Schepers, Anne Oudinot, both Senior Reservoir Engineers with Advanced Resources International, Inc., and Nino Ripepi with Virginia Center for Coal and Energy Research won the 2011 AAPG Eastern Section A. I. Levorsen Award for the best paper presented during the September 26-27, 2011 section meeting. This work described how to optimize injected gas composition in Coal Bed Methane reservoirs, in order to improve CO<sub>2</sub> sequestration while preserving injectivity. Key parameters driving enhanced coal-bed methane recovery and CO<sub>2</sub> sequestration were identified for common mature coal basins in the US and reservoir simulation tools were used to optimize their development. This innovative methodology could help turn non-economic coal bed and gas shale into profitable plays.



### HOUSTON OFFICE HAS MOVED!

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### AREA MAP

**Our phone numbers remain the same:**  
**Phone:** 281-558-9200  
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### UPCOMING EVENTS



**Carbon Management Technology Conference**

Caribe Royale Hotel & Convention Center  
Orlando, Florida  
February 7-9, 2012  
[www.carbonmgmt.org/pages/general/registration.php](http://www.carbonmgmt.org/pages/general/registration.php)

**Southern States Energy Board's Associate Members Meeting & Luncheon**

Marriott Metro Center  
775 12th Street NW  
Washington, DC 20005  
February 27, 2012  
<https://s07.123signup.com/servlet/SignUp?PG=1531834182300&P=153183400>

**12 AIChE Spring Meeting and 8th Global Congress on Process Safety**

Hilton-Americas Houston and George Brown Convention Center  
Houston, TX  
April 1-5, 2012  
[www.aiche.org/Conferences/SpringMeeting](http://www.aiche.org/Conferences/SpringMeeting)

**AAPG 2012 Annual Convention & Exhibition**

April 22-25, 2012  
Book Rooms through the AAPG Housing Bureau  
Long Beach, California  
[www.aapg.org/longbeach2012](http://www.aapg.org/longbeach2012)

**OTC 2012**

April 30th – May 3rd, 2012  
Book Rooms through OTC's Housing Provider  
Houston, TX  
[www.otcnet.org/2012](http://www.otcnet.org/2012)

For a complete list of industry news, recent white papers and case studies please visit our website [www.adv-res.com](http://www.adv-res.com) or contact one of our offices:

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