



Society of Petroleum Engineers

4–7 October 2010 | Park Rotana | Abu Dhabi, United Arab Emirates

**Early Bird Registration Deadline:  
27 August 2010**

# ***SPE Applied Technology Workshop*** ***CO<sub>2</sub> EOR Projects: Opportunities and Challenges*** ***in the Middle East***



## **Who Should Attend**

- CO<sub>2</sub> Project Managers
- Surface Facilities Engineers
- Production Engineers
- Drilling Engineers
- Geoscientists
- Petrophysicists
- Petroleum and Reservoir Engineers
- Carbon Capture and Management Teams
- Scientists and Researchers
- University and Academia

## **Committee Members**

### **Co-chairperson**

**Abbas Al-Alyak**  
ADMA-OPCO

### **Co-chairperson**

**Mohamed Doghmi**  
Schlumberger

**Abdurazak Zekri**, UAE University

**Arafat Al-Yafei**, ADNOC

**Badar Al-Matar**, R&T-KOC

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**Hemanta Sarma**, PI

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**Kristian Mogensen**, Maersk Oil

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**Othman Zarzour**, Masdar

**Remy Truchetet**, Total

**Sikandar Ali Memon**, ADCO

**Soren Frank**, Maersk Oil

**Sunil Kokal**, Saudi Aramco

**Daisuke Urasaki**, JODCO

**Zara Khatib**, Shell

## **Workshop Abstract**

CO<sub>2</sub> injection has been identified as one of the most promising EOR methods worldwide. As some of the Middle Eastern fields start maturing, alternative IOR/EOR methods should be screened for economical and environmental reasons.

A number of NOCs in the Gulf region have announced ambitious EOR piloting involving CO<sub>2</sub> injection in their oilfields. The technology is being driven by both a practical desire to improve recovery in existing fields and a desire to sequester significant volumes of produced CO<sub>2</sub>.

Although CO<sub>2</sub> has the ability to enhance hydrocarbon recovery beyond levels possible with primary and secondary recovery methods and that the method has been demonstrated commercially in other parts of the world, it remains untested in the Middle Eastern Gulf region. Many of these pilots have different objectives but they all have similar challenges ranging from proper reservoir characterisation and well construction all the way to adequate surface facilities able to handle CO<sub>2</sub> and economic justifications.

For a CO<sub>2</sub> EOR project to be successful, it is necessary to be able to obtain CO<sub>2</sub> at a reasonable economic cost and to inject, monitor and control the CO<sub>2</sub> pathways in the reservoir. There are a number of technologies available or under development to improve reservoir characterisation, subsurface modelling and simulation as well as measure EOR performance in terms of sweep efficiency and conformance.

This workshop will bring together a number of global experts on CO<sub>2</sub> enhanced oil recovery to discuss the technical and commercial feasibility of these applications, issues and challenges. The workshop will also bring several field pilots and case studies to the discussion. Participants will be able to exchange ideas and build a network of knowledgeable resources from different companies and countries around the world.

**[www.spe.org/events/10aab4](http://www.spe.org/events/10aab4)**

# WORKSHOP

## CO<sub>2</sub> EOR Projects: Opportunities and Challenges in the Middle East

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### For More Information

For a detailed list of available sponsorships, including benefits and pricing, contact Ahmed Fahmy, at [afahmy@spe.org](mailto:afahmy@spe.org).

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5 October Coffee Break



Audio Visual Equipment Sponsor



### Schedule

#### Monday, 4 October 2010

1800–2000 hours

Collection of Badges and Delegate Packs

#### Tuesday, 5 October 2010

0830–0900 hours

Opening, Welcome and Workshop Introduction

0900–1030 hours

**Session 1: Panel Discussion - Vision of CO<sub>2</sub> EOR in the Middle East**

The panel will introduce the vision and the drivers for Carbon Dioxide –Enhanced Oil Recovery application in the Middle East with special emphasis on the ongoing UAE experience and regional aspirations. Current status of the worldwide implementations and experiences of CO<sub>2</sub> EOR will be discussed relative to the context of Middle East anticipated field applications.

How we define success criteria for large scale applications and what could limit rapid adoption of the technology will be expounded.

1100–1230 hours

**Session 2: Road Map for CO<sub>2</sub> EOR Project**

The industry has a long experience with the CO<sub>2</sub> EOR projects and a long wish list for a perfect project. It is being proven that there are fundamental building blocks in those projects which are open for significant improvement. That list goes with development of a representative PVT for the reservoir system, up scaling lab-to-field, reservoir characterisation suitable for predictive modelling, understanding the multi-phase flow regimes and monitoring and control system for CO<sub>2</sub> EOR projects. Most of these fundamental issues have been identified in numerous times but full resolution has not yet been achieved.

On the other hand, how important it is for CO<sub>2</sub> EOR project to coincide with CCS? What role can CCS play in decarbonising our economies? Is carbon capture, utilisation, and storage the natural evolution of the CO<sub>2</sub> EOR concept? What role is policy set to play in the future of CCS?

1330–1500 hours

**Session 3: CO<sub>2</sub> Essentials: Tools You Need to Get Started**

The session will start with the identification of basic process mechanisms likely to be experienced in a CO<sub>2</sub> injection project and will highlight relative importance and the impact of various process parameters. In that context, the importance of preparatory SCAL and PVT/EOS studies in understanding and designing optimal CO<sub>2</sub> injection strategy will be discussed, in addition to the problems of asphaltene precipitation and deposition, formation of emulsions and the role of formation water in surface and sub-surface during the process.

1530–1700 hours

**Session 4: CO<sub>2</sub> EOR Mechanisms**

Recovery mechanisms in CO<sub>2</sub> flooding range from reduction in oil viscosity to oil swelling and dissolved-gas drive in immiscible processes and reduction of interfacial tension as the miscibility is approached. In this session we will focus on fundamental CO<sub>2</sub> recovery mechanisms including displacement and sweep efficiencies, compositional effects on oil recovery, viscous fingering, channelling and gravity segregation. Others topics will cover CO<sub>2</sub> volume requirements for secondary and tertiary recovery applications, basic mobility control schemes such as water alternating CO<sub>2</sub> injection, recovery performance with pressure near or below miscibility and influence of reservoir heterogeneities and fractures.

#### Wednesday, 6 October 2010

0900–1030 hours

**Session 5: Simulation Challenges**

The preparation of a pilot or field development with CO<sub>2</sub> injection is designed with the use of numerical simulations taking into account the behaviour of CO<sub>2</sub> with the fluids in place and the porous media based on specific PVT and SCAL measurements. The way to accurately represent the CO<sub>2</sub> in a simulation model is a real challenge and is different with the various in-house or market simulators. Some trade-offs have to be taken and their impact has to be evaluated. The objectives of this session are to highlight and explicit the various approaches taken, the precise data deemed necessary to have a proper representation, share experience in the use of various simulators and field cases, and finally define the way for the future.

1100–1230 hours

**Session 6: Surveillance and Monitoring – Reservoir**

Designing a CO<sub>2</sub> EOR pilot and implementing it is long and complex. Pilot testing is usually the best way to collect data and validate the performance of a particular EOR process in the field. Therefore a systematic approach with clearly defined objectives and performance indicators as well as comprehensive surveillance and monitoring programme need to be put in place.

This session will discuss:

- CO<sub>2</sub> EOR: Pilot design key objectives and parameters
- CO<sub>2</sub> EOR Monitoring at the well scale, at the reservoir and field scale
- New technologies to better understand sweep and conformance
- How the surveillance helps assure a successful CO<sub>2</sub> EOR project

## 1300–1500 hours **Session 7: Well Integrity and Potential HSE Related Challenges Under CO<sub>2</sub> Conditions**

Drilling, completion and well operations involve a number of HSE challenges. The major challenge is well integrity. This session focuses on the current challenges and practices related to well integrity particularly during CO<sub>2</sub> injection and production as a component of associated gas, water-alternating CO<sub>2</sub> and acid gas. Discussion leaders will address:

- Geo-mechanical considerations of the rock under difficult pressure and temperature conditions in the reservoirs
- CO<sub>2</sub> degradation mechanisms for the different well completion components, such as cement, steel, elastomers, etc. during injection and production
- Best practices on the maintenance of the integrity of wells, monitoring approaches used for early detection of leakage, and remediation options that could be used to mitigate the leaks
- Possible 'blind spots' such as conductor integrity, corrosion and material selection and engineering competence, shut-down systems of the christmas tree, wellhead, and down-hole emergency and emergency response in case of failure

Potential well integrity scenarios and their likely repair options with greater requirements related to technology and competence and technical solutions to prevent undesirable incidents will be discussed in workgroups sessions led by discussion leaders.

## 1530–1730 hours **Session 8: CO<sub>2</sub> EOR: Emerging Technologies**

Although CO<sub>2</sub> has the ability to enhance hydrocarbon recovery beyond levels possible with primary and secondary recovery methods, the displacement efficiency could be less than expected due to channelling, fingering and gravity segregation of the injected CO<sub>2</sub>. The conformance could be a serious challenge in reservoirs with contrasting permeability and/or trending fractures and the control is crucial in optimising the oil recovery and maximising the CO<sub>2</sub> storage. While several large-volume foam-gel injector treatments have been suggested to improve the in depth conformance, the applicability and cost-effectiveness of the approach for carbonate reservoirs is currently being researched. In this session, we will focus on emerging technologies or measures that could have immediate benefit in CO<sub>2</sub> EOR applications.

## Thursday, 7 October 2010

### 0900–1030 hours **Session 9: Surface Facilities**

This session will address the surface facilities aspects of CO<sub>2</sub> EOR projects. Surface facilities for CO<sub>2</sub> flood generally involve substantial capital investment. Topics covered include design of CO<sub>2</sub> compression system, CO<sub>2</sub> pipelines and material selection issues. Technologies for separating CO<sub>2</sub> from hydrocarbon gases are also reviewed. Since most CO<sub>2</sub> EOR projects are implemented on existing oilfields, the session will also discuss how best to evaluate the impact of CO<sub>2</sub> on existing surface facilities in terms of equipment performance and corrosion. Economic benefits for CO<sub>2</sub> EOR projects tend to be weighted towards the back end of the project. The importance of having a phased approach to investment will be also discussed.

### 1100–1230 hours **Session 10: Case Studies - Lessons Learnt**

The oil and gas industry's experiences, findings and learning's are significant in CO<sub>2</sub> EOR with numerous technological and engineering advances made over the past 35 years. The expertise gained in technology and operational practices used in handling and injecting CO<sub>2</sub> should be considered a valuable resource in planning and implementation of current and future CO<sub>2</sub> EOR projects. The designing and implementation of CO<sub>2</sub> EOR project is going through a complex process. Today's theoretical information on CO<sub>2</sub> EOR projects is also vast but its implementation in real field experience poses a real challenge.

The objectives of this case studies session is to present the CO<sub>2</sub> EOR real projects experienced focusing on full lifecycle of a CO<sub>2</sub> EOR projects with the intent of illustrating and sharing the successful and best practiced of technology and operational practices that have been developed for CO<sub>2</sub> EOR projects, shortcoming and challenges experienced and various other field findings which may be adaptable to CO<sub>2</sub> EOR projects.

### 1330–1500 hours **Session 11: Opportunities and Way Forward**

This session will explore the opportunities to overcome challenges facing CO<sub>2</sub> EOR. Some of these include addressing the CO<sub>2</sub> availability issue, new technologies to reduce the cost of CO<sub>2</sub> capture, mitigating gravity segregation issues through WAG optimisation, use of foams, surfactants, thickeners, addressing the synergies between CO<sub>2</sub> EOR and CO<sub>2</sub> sequestration, making CO<sub>2</sub> EOR as part of the CDM, and recent development in monitoring and surveillance. Ideas exploring the future of CO<sub>2</sub> EOR will be discussed in this session.

### 1500–1530 hours **Workshop Concluding Remarks**

## Workshop Venue

Park Rotana  
P.O. Box 43377, Abu Dhabi, UAE  
Tel: +971.2.657.3333  
Fax: +971.2.657.3000  
park.hotel@rotana.com

## Workshop Guidelines

### Format

Three (3) days of informal discussions prompted by selected keynote presentations and discussions. Workshops maximise the exchange of ideas among attendees and presenters through brief technical presentations followed by extended Q&A periods. Focused topics attract an informed audience eager to discuss issues critical to advancing both technology and best practices. The majority of the presentations are in the form of case studies, highlighting engineering achievements and lessons learned. In order to stimulate frank discussion, no proceedings are published and the press is not invited to attend.

### Documentation

- Proceedings will not be published; therefore, formal papers and handouts are not expected from speakers.
- Work in progress, new ideas, and interesting projects are sought.
- Professionally-prepared visual aids are not required; handwritten view graphs are entirely acceptable.
- Note-taking by participants is encouraged.

### Poster Session

The Steering Committee encourages registrations from professionals who are able to prepare and present a poster on a relevant project. For further details kindly contact Ahmed Fahmy, business development manager at [afahmy@spe.org](mailto:afahmy@spe.org).

### Attendance

Registrations will be accepted on a first-come first-serve basis. The Steering Committee encourages attendance from those who can contribute to the workshop most effectively either in discussions or with posters. A mix of attendees in terms of geographic origin, companies and disciplines will be encouraged.

### Workshop Deliverables

- The Steering Committee will appoint a "scribe" to record the discussions and to produce the full workshop report for SPE.
- This report will be circulated to all attendees as the workshop deliverable within 4–6 weeks following the workshop. The copyright of the report is with SPE.
- PowerPoint presentation materials will be posted on a specific SPE URL address after the workshop. Provision of the materials by the speakers will signify their permission for SPE to do so.

### Commercialism

In keeping with ATW objectives and the SPE mission, commercialism in posters or presentations will not be permitted. Company logos must be limited to the title slide and used only to indicate the affiliation of the presenter and others involved in the work.

### Attendance Certificate

All attendees will receive an attendance certificate attesting to their participation in the workshop. This certificate will be provided in exchange for a completed Workshop Questionnaire.

### Continuing Education Units

Attendees at this workshop qualify for SPE Continuing Education Units (CEU) at the rate of 0.1 CEU per hour of the Workshop.

**PLEASE USE INSIDE FORM FOR REGISTRATION**

