

# R&D Conference Examines Hydrocarbon Sustainability

Ted Moon, *JPT Online* Technology Editor

With global energy demand predicted to grow substantially in the next 30 years, the oil and gas industry will be expected to continue providing the lion's share of future supply. With a theme of "Fueling the Future," the 2009 SPE Research & Development (R&D) Conference investigated the new technologies and energy players required to meet the world's energy needs.

Nearly 100 attendees converged on Lisbon, Portugal this year to discuss the R&D disciplines that would ensure hydrocarbons' role as a major energy source in the coming decades. Major conference themes included: maximizing recoveries from known fields, discovering and exploiting new reserves, unlocking trapped energy molecules, solving water-management challenges, and increasing productivity in a time of manpower and resource shortages.

## Fueling the Future

In the first session, leading scientists and economists framed the challenges that confront the industry in providing sufficient energy supplies for the global economy. John Barry, vice president, Unconventionals and Enhanced Oil Recovery (EOR) for Shell, discussed technology's vital role in extracting more hydrocarbons from increasingly challenging areas, while also keeping costs down and managing CO<sub>2</sub> emissions. He estimated that there are nearly 2 trillion barrels of challenging reserves in the form of heavy oil, oil and gas shales, and in Arctic and ultradeepwater regions. Tapping this vast resource will require further investment in offshore satellite developments, power from renewable resources, more smart well completions, and new deepwater and Arctic rig technology.

Chief Economist Dave Larson with PFC Energy next reviewed the impact of the global financial crisis on the

energy industry. He said that the industry is reeling from a triple blow of collapsing oil price, decline in hydrocarbon demand that may persist for years, and the drying up of new credit availability, all of which will hamper normal business financing and cause some E&P programs to be postponed or cancelled, which has already begun. In the long-term, Larson said that there is no fundamental change to the expected future supply/demand crunch and that this crisis may create growth opportunities, particularly for national oil companies (NOCs). "NOCs with strong balance sheets, solid cash positions, and low debt ratios will be well-positioned to emerge as major global players," he said.

## Discovering Future Reserves

The second session reviewed the new seismic, remote-sensing, and drilling technologies required to discover future reserves from increasingly challenging areas. Gerhard Thonhauser of TDE Thonhauser Data Engineering discussed drilling in extreme environments like desert and Arctic regions, high-pressure and high-temperature reservoirs, and ultradeep geographic targets. He called for an industrywide step-change in drilling efficiency, which can be achieved by developing an ultralight drillstring concept to expand the drilling envelope, drilling more offshore targets from less expensive land-based operations, and by reaching deeper targets with existing rigs. Developmental challenges include material compatibility with hostile downhole environments, hydraulics limitations, and poor wear and torsion resistance.

## Maximizing Ultimate Recoveries

The third session discussed new reservoir technologies with the potential to increase hydrocarbon recovery.

Saudi Aramco's AbdulAziz Al-Kaabi first discussed his company's upstream strategies. Al-Kaabi emphasized research in cross-well electrotomography, measurement-while-drilling-NMR tools to drill the first slimhole, EOR technologies, and CO<sub>2</sub> capture and injection. He also highlighted a feasibility study for using nanotechnology to improve recovery, with long-term plans including employing so-called "Resbots" for governing the use of nanoparticles in cores and conducting high-resolution reservoir simulations.

Ayusman Sen, professor of chemistry at the Pennsylvania State University, discussed his research on nanoparticle motion. Sen said that a major achievement to date has been the ability to control nanoparticle movement by applying electrical or magnetic fields. Emmanuel Ganelis, professor of materials science & engineering with Cornell University, focused on the potential of nanoparticle ionic materials. Citing their unique interfacial properties as improving miscibility and dispersion for greater reservoir sweep efficiencies, Ganelis said that these materials can positively impact waterflood rheology for better crude oil displacement, alter wettability, and act as capture media for carbon capture and sequestration projects.

Gordon Moore, professor of chemical engineering with the University of Calgary, discussed light-oil air injection and in-situ combustion techniques for increasing production. High pore-scale displacement efficiencies, reduced water requirement compared to steam-injection processes, and the applicability to a wide range of reservoirs and fluid characteristics are the advantages of these methods. Moore also noted the importance of safety and advocated using synthetic lubricants to avoid

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fire risks and using two compressors to ensure uninterrupted air injection to avoid damage caused by near-well-bore backflow.

### Unlocking Alternative Sources

This session started with the discussion on commercial biofuel cells for energy generation. A large-scale project is underway at the Universidade Nova de Lisboa in Portugal to generate electricity from *Rhodospirillum rubrum* bacteria from oil rigs using low-cost electrode materials. The bacteria are genetically engineered to self-replicate, and within two years, researchers aim to generate 30% of a regular household's electricity with the resulting biofuel cell.

Clemens Posten of the Universität Karlsruhe in Germany next discussed large-scale microalgae production for energy use. Posten said that the photoconversion efficiency of microalgae is 5 times greater than that for sugar cane. Though many current production designs are too expensive to be economically viable, he said that coupling microalgae production to a biogas production facility for food sources is the most efficient current method.

### Water Challenges

The fifth session examined management of the industry's water needs. "This session provided a better appreciation of the water-management issues in the industry, leading to a better focus for the direction of R&D opportunities," said Session Cochair and Technical Adviser for ConocoPhillips, David Zornes.

Keynote Speaker Paul Verbeek of Shell discussed the beneficial uses of produced water. He stated that as fresh water becomes more scarce with global population growth, increasing standards of living in developing countries, and rapid industrialization, the reuse of produced water is becoming more attractive to the oil and gas industry. Verbeek then discussed the positive impact produced water could have in biofuel processing and EOR.

Total's Frederique Michaud next discussed the water challenges in heavy oil production. "Thermal SAGD-heavy oil requires only 0.3–0.5 bbl water/bbl of oil produced once you take into account the recycling," Michaud said, "whereas bitumen mining utilizes

2–4 bbl water/bbl of oil recovered." Michaud highlighted the increasing challenges of total dissolved solids such as silica in water recycling, and called for the development of cleanable/recyclable ceramic membranes.

Colin Smith of Maxoil Solutions stressed the need for new membrane-filtration technologies for desalination. He highlighted ceramics and zeolites for filtration, molecular sieves, ceramic cross-flow filters, microfiltration membranes, and tubular microfiltration. To treat the common problem of fouling with membrane filters, new vibration technologies have been developed to clean them. Ongoing pilot trials show promise.

### Unlocking More Hydrocarbon Sources

This session's keynote address by Shell's John Barry discussed innovative methods for unlocking hydrocarbons, including smart wells and fields, chemical EOR, low-salinity waterflooding, oil sands in-situ upgrading, carbon capture and sequestration's emerging challenges, and Arctic production. He reviewed several production enhancement scenarios, including how smart fields can reduce production costs by USD 1–2/bbl and delay water breakthrough for years. Barry stressed that technology breakthroughs don't come quickly, citing a gas-to-liquids technology development program that lasted 33 years.

Amos Nur presented a new computational rock physics methodology that is being developed at Ingrain. This methodology includes high-resolution and fast 3D imaging of pore spaces of rock samples which can be used to accurately and quickly compute bulk properties and simulate pore-scale processes.

Jeff Spath of Schlumberger covered shale gas R&D. He discussed where gas is stored in gas shales and how gas production from the fracture network can be optimized. He reviewed the challenges to be addressed and identified the current industry R&D activities and directions for continued research.

### Increasing Productivity Through Technology

The final session highlighted potential advanced-technology solutions that better leverage employee skills, accelerate innovation, and significantly increase worker productivity. Jacob Thomas

with Halliburton reviewed the workforce productivity gains afforded by real-time, remote monitoring and operating technologies, including real-time operating centers and virtual collaborations. Schlumberger's Louis-Pierre Guillaume discussed the potential of instant messaging and online chat for quickly locating subject experts and querying knowledge databases through the chat.

IBM's Adrian Chapman spoke on the power of Web 2.0 and virtual worlds as a means to collaborate more effectively. "Chapman's presentation was quite interesting," said ExxonMobil's Richard Felder, who cochaired the session. "He addressed how the changing nature of work will require more collaborative ways of working in the future and, in particular, how virtual social worlds coupled with 3D Internet capabilities can significantly improve interactive marketing/commerce, collaboration, education/training, and complex system management."

A longer version of this article is available on JPT Online: [www.spe.org/jpt/2009/06/rd-conf-2009](http://www.spe.org/jpt/2009/06/rd-conf-2009). **JPT**

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