

Monday, March 30, 2009

# HGS North American Explorationists Dinner Meeting

Westchase Hilton • 9999 Westheimer

Social Hour 5:30-6:30 p.m. • Dinner 6:30-7:30 p.m.

Cost: \$28 pre-registered members; \$35 for non-members & walk-ups;  
Emeritus/Life/Honorary: \$14; Students: FREE

To guarantee a seat, you must pre-register on the HGS website and pre-pay with a credit card.

Pre-registration without payment will not be accepted.

You may still walk up and pay at the door, if extra seats are available.

Arthur E. Berman

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## Shale Plays, Risk Analysis, and Other Perils of Conventional Thinking

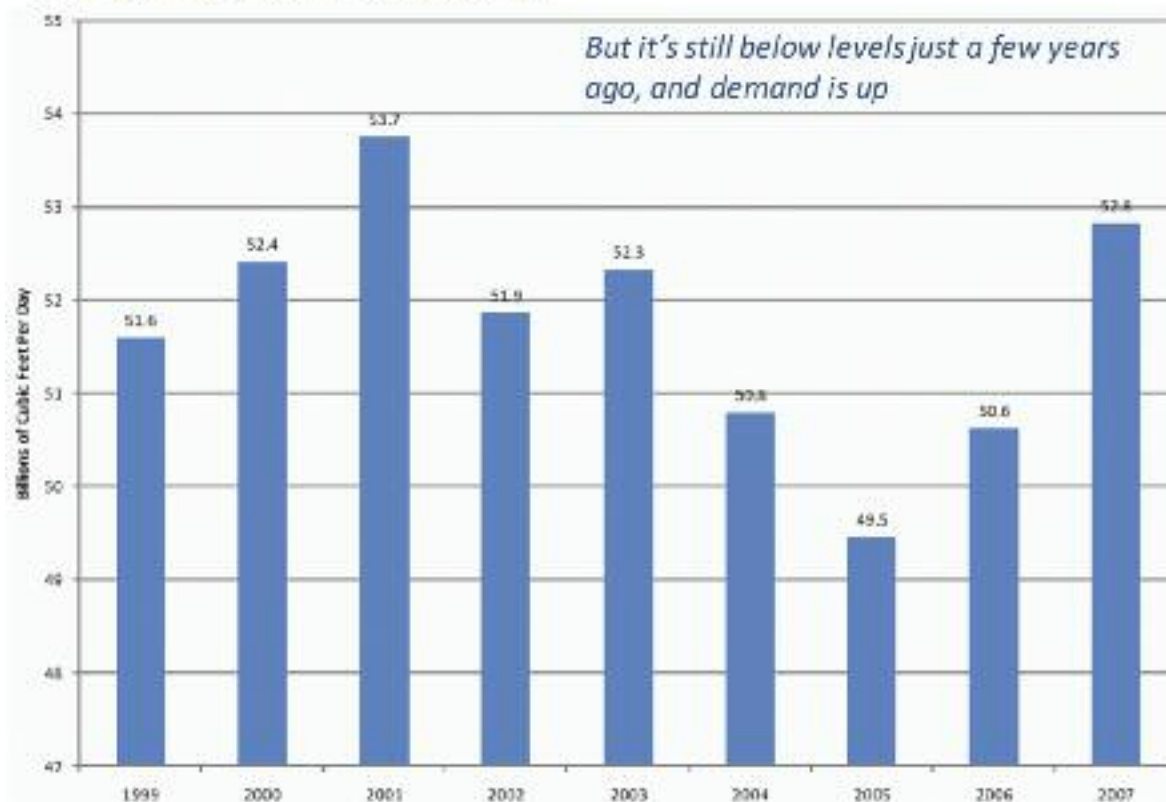
In mid-July 2008, the United States somewhat unexpectedly discovered that it had an oversupply of natural gas and prices fell sharply. Jen Snyder, head of Wood Mackenzie Limited's North American Gas Research Group, recently said that the development of shale gas plays has caused "a significant potential over-supply" (*Oil and Gas Journal*, December 1, 2008). Shale plays had become increasingly irresistible to the North American industry before prices fell this summer. Many traditional E&P companies, including some majors, decided to become shale gas players, and many are still considering the possibility despite low gas prices. The global financial crisis has accentuated the aversion to risk that fueled shale plays to begin with, and it seems that no one

now wants to pursue anything but shale. I believe that we have finally arrived at the end of domestic onshore exploration. In the first half of July 2008, spot gas prices were more than \$13.00 per million British thermal units (MMBtu). Six weeks later, the price had fallen below \$8.00, and it has averaged around \$6.75 per MMBtu since October 2008. Some analysts predict that gas prices will be in the \$5.00-6.00 per MMBtu range at least through the end of 2010.

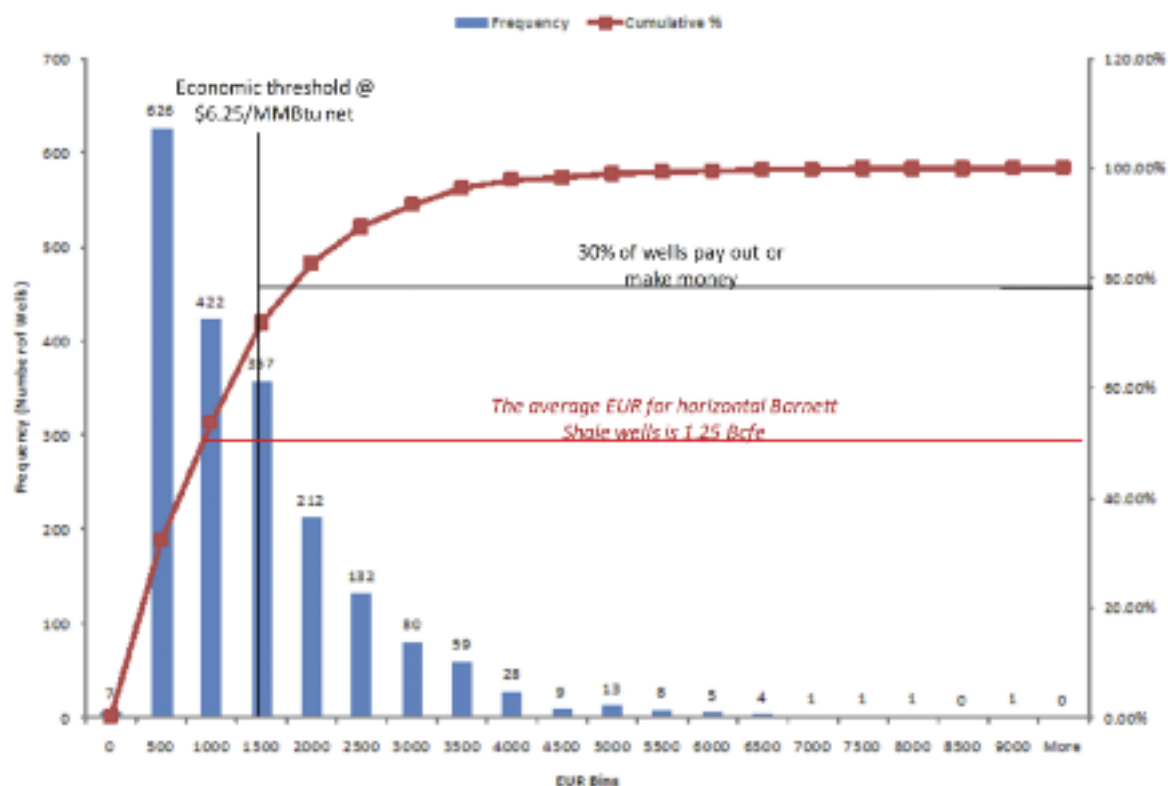
A total of 1,966 horizontally-drilled wells producing from the Barnett Shale were evaluated to determine commercial gas

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### U.S. Gas Production Has Increased



### Barnett Shale Horizontal EUR Histogram (1966 wells)



reserves using standard decline methods. Based on this analysis, only 30% of Barnett Shale wells will realize revenues that meet or exceed drilling, completion, and operating costs in the most-likely case based on assumptions incorporated into a 10% net present value (NPV10) economic model. The economic model includes per-well drilling and completion costs of \$3.25 million, a wellhead gas price of \$6.25 per MMBtu (the average spot sales price for 2007), 75% net revenue interest, 7.5% Texas severance tax, and \$1.25 per thousand cubic feet of gas (Mcf) lease operating and overhead cost. These assumptions are consistent with information published by a UBS consortium of independent gas producers, including key Barnett Shale operators Chesapeake, Devon, EOG, and XTO. The model requires per-well cumulative production of about 1,325 million cubic feet of gas (MMcfe) over 10 years to reach a commercial threshold.

A scoping analysis was done to compare early information (reported initial production rates) of the Haynesville Shale with data from the Barnett Shale. The results suggest that Haynesville per-well reserves may be two to three times higher than in the Barnett Shale. Drilling, completion, and leasing prices are correspondingly higher in the Haynesville, so it is difficult to conclude that full-cycle Haynesville economics will be much different than the more well-established Barnett data.

I have struggled to understand the appeal of shale plays based on

economic factors, and thought that low gas prices would greatly reduce activity. At \$10.00 per MMBtu, about half of horizontally drilled and fracture-stimulated Barnett Shale wells were commercial. So, while prices were rising even higher, shale plays made some sense. At current prices, however, only about 25% of Barnett wells pay out, and all indications are that prices will fall lower or, at best, remain at current levels. While leasing has largely stopped, drilling continues, and the enthusiasm of both companies and analysts seems strong, at least for the Barnett, Haynesville, and Fayetteville shales.

#### How can we understand what is happening with shale plays?

The diffusion model of innovation (Ryan and Gross, 1943, and Rogers, 1962) shows that people adopt new ideas and technologies slowly, and that only about 5% of people make the decision to adopt based on information. The other 95% decide because of the views of opinion leaders in the community, and on the eventual social momentum that develops—what Malcolm Gladwell called the “tipping point.” The 5% who base decisions on information in the diffusion model are critical thinkers; the rest are conventional thinkers.

What causes people to decide to abandon an idea that almost everyone previously accepted? It is reasonable that only critical

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thinkers make this decision based on information, and that conventional thinkers follow in what may become a stampede. Thomas Kuhn (1962) explained that scientists resist abandoning a ruling theory in favor of a new paradigm with a kind of orthodox fervor of conventional thinking, and often ostracize those critical thinkers who point out problems with the existing model. At some point, when opinion shifts to support a new paradigm, the previous theory is unceremoniously dropped, and its remaining supporters are criticized as dinosaurs.

A review of some of the history of how our industry arrived at its present state is relevant. The collapse of oil prices in 1982-1986 and the ensuing 13 years of over-supply and low prices created an environment in the E&P business in which cutting cost and reducing risk were paramount. Thousands of jobs were lost and companies disappeared as layoffs, reorganizations, mergers, and consolidation became the core business of oil and gas companies.

As oil prices slowly recovered in the late 1990s, risk analysis teams were formed to manage technical work. Executives abdicated their technical responsibilities to risk committees and turned their attention to business models. With the help of consultants, they envisioned companies in which exploration and production would become a manufacturing operation, and risk was eliminated. Execution was paramount, standardization was essential, and new geological ideas were unnecessary. The new vision for the E&P business represented the victory of conventional over critical thinking.

Shale plays not only satisfied this model, but also solved the perennial E&P problem of being opportunity-constrained. That is, because shale is practically ubiquitous, there are no limits to what can be spent pursuing new and existing opportunities. This shift was widely supported by the capital investment community because of the low perceived risk, and the fact that non-scientists could understand the play.

Returning to the present, the myths about the current state of domestic E&P must be clarified to put shale plays in context. These plays are an important component of domestic natural gas production, but they represent a relatively small—though growing—portion of the total gas supply. Even among unconventional gas resources, tight gas and coal-bed methane dominate production.

Second, these plays involve considerable risk. The fact that 75% of wells are commercial failures at current gas prices is a tangible risk. Great emphasis is placed on engineering ideas and technology,

but it seems that concern for geological and geophysical understanding is uneven among shale players. Each shale play is different and requires unique approaches based on thermal maturity, structural factors, fracturability, and identification of sweet spots.

Third, economic models must be aligned with full-cycle PV10 industry standards. Wood MacKenzie's Snyder says that established shale plays have "sufficient volumes available at a development break-even price of \$5.50 per MMBtu or below" (*Oil and Gas Journal*, December 1, 2008). I do not believe that. I do not know any credible industry analysts who believe that shale plays are commercial below \$8.00 per MMBtu. The only way to arrive at

the thresholds that Snyder mentions is to understate or ignore current levels of capital expenditure, as well as costs associated with general and administrative operations, lease operations, midstream, and discounted capital costs, or to inflate rates and reserves beyond what can be supported by performance history.

Additionally, the over-supply of natural gas that analysts describe may be

relative, and that would be positive for shale plays. Spot prices rose to \$13.00 per MMcf in mid-2008 because of an imbalance between supply and demand. Prices fell when about two billion cubic feet per day (Bcfd) of additional supply came online from the Independence Hub, Thunder Horse, and Tahiti fields in the offshore Gulf of Mexico, in addition to increased unconventional gas production, including shale gas. Monthly natural gas production over the past year averaged approximately 1.75 trillion cubic feet per day (Tcfd). The additional 2 to 3 Bcfd resulted in an over-supply is only 3.5-5.5% of total production. Many circumstances might quickly upset the supply-demand balance and result in higher prices. At the same time, the global financial crisis will probably reduce demand and somewhat offset other factors that may favor rising price. The point, however, is that the difference between what the market perceives as over- and under-supply can be razor-thin.

Finally, rig counts and rates have fallen sharply in recent weeks, and some predict that hundreds of rigs will be idle in early 2009. Unconventional wells have steep decline rates, and any decrease in drilling activity will quickly result in dramatically lower gas production from these plays. That, in turn, will affect supply and prices could rise, but this may also expose the ephemeral contribution of unconventional gas sources to total natural gas supply.

There is little doubt that shale plays are likely to be important for

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some time. I hope that operators will continue to learn how to reduce costs, optimize production, and better incorporate geology and geophysics into their play strategies. Whether the United States has a long-term over-supply of natural gas, or that today's surplus is chiefly due to shale gas production is not certain.

In the E&P business, shale plays represent a disturbing tendency away from critical thinking. The belief in reward without risk is irrational. The failure to acknowledge the marginal economics of the play is bewildering. Unless opinion leaders confront the underlying economic and geological risks of these plays, I fear that a financial crisis may develop that will discredit the E&P industry. ■

### **Biographical Sketch**

**ARTHUR BERMAN** is a geological consultant whose specialties are subsurface petroleum geology, seismic interpretation, and database design and management. He is currently consulting for several independent and international oil companies on interpretation and mapping projects. His current clients include Vision Resources, Total, PetroChina, and Schlumberger.

He is a contributing editor and columnist for *World Oil* and writes a monthly column called "What's New in Exploration."

He is also an associate editor in the American Association of Petroleum Geologists (AAPG) and Vice-President of the Houston Geological Society (HGS). He is a past-editor of the *HGS Bulletin* (2004-2005).

He has published over 50 articles on geology, technology, and the petroleum industry during the past

ten years on topics including petroleum exploration, sequence stratigraphy, oil and gas price trends and cycles, coastal subsidence, earthquakes, tsunamis, and petroleum geopolitics. He has given technical presentations to the AAPG; GCSSEPM; Houston Geological Society; Houston Geophysical Society; GCAGS; SIPES Austin, Houston, Dallas, and Corpus Christi chapters; South Texas Geological Society; Association of Engineering & Environmental Geologists; San Antonio Geophysical Society; and American Association of Civil Engineers.

Mr. Berman has an M.S. in geology from the Colorado School of Mines and a B.A. in history from Amherst College.

