Altenews Interview with Brian Hughes

Brian Hughes has a BS in Engineering from West Point and an MS in Petroleum Engineering from the University of Texas. He has worked as a petroleum engineer for Shell, and as an independent consulting engineer for eighteen years. He currently heads Tatonka Oil and Gas, a company involved in coal bed methane and shale oil exploration. He is an expert in coal bed methane, one of the areas of independent oil and gas exploration that is becoming exciting for investors. We talked to him about coal bed methane technology, exploration, and economics, and how coal bed methane can help the environment and developing countries.

Will coal bed methane become a major rival of traditional natural gas?

Yes. Coal bed methane will be a significant competitor to conventional natural gas, very much so. The potential resources of coal bed methane contained in world coal greatly exceeds known conventional natural gas resources. It is sometimes in multiple quadrillion cubic feet. In many conditions coal bed contains three times more than gas in equivalent thicknesses of limestone and sandstone.

What is coal bed methane?

Coal bed methane is a byproduct of the coalification process. It consists of almost pure methane, in the majority of fields. There are two types of coal bed methane, biogenic and thermogenic. Biogenic gas is formed by bacterial action in the coal. Thermogenic gas is formed by heat and pressure. Sometimes there are minor constituents of nitrogen and carbon dioxide. The coal bed methane requires very little processing in the majority of instances and is pipeline quality gas, especially the biogenic gas.

How do you produce coal bed methane?

Coal bed methane is kept within coal by pressure. To produce the gas the water in the coal bed has to be removed, generally by using pumps. As pressure is reduced, the gas desorbs from the coal, flows to the well, and flows up the casing. At the wellhead, the flow rate is measured, and the gas is collected and compressed for transmission via pipelines to household, commercial and industrial users hundreds to thousands of miles away.

Is coal bed methane like natural gas in its composition?

Yes, coal bed methane is almost identical to what we call ‘natural gas’ in its final form; basically, it is just methane (CH_4), without the more complex molecules (ethane, propane, butane) found in trace amounts in ‘natural gas’ delivered to homes and industries. CBM has a heat content a little higher than 950 btu/cf, which is the same btu content in cooking stoves.

What is the CBM extracted from?

Primarily from bituminous and sub-bituminous coals. Lignite, which is a lower rank than sub-bituminous, generally has limited permeability and gas content. You need to get to the sub-bituminous coals to have a significantly better possibility to produce coal bed methane. In general, permeability decreases and gas content increases with increasing coal rank.

What technology developments are needed for better CBM extraction?

No special technology is needed. The Powder River basin in Wyoming started using water well technology; in other basins, modified conventional oil and gas technologies were used. The most significant technology used was specialized pump controllers, which allows the operator to monitor production rates of pressures. In some of the deeper coal bed methane basins hydraulic fracturing and to a limited degree cavity completions are used to complete the wells.

What does the price of natural gas have to be for feasible economic extraction of CBM?

That depends upon the cost structure of the basin. For the Powder River basin in 2000, it was about $2 per thousand cubic feet (mcf) break even cost. Now, the break-even cost is probably closer to $4/mcf. It depends on drilling costs, services, and costs to collect and transport the CBM.

Where are the best coal bed methane opportunities?

The most prolific coal bed methane production is from the San Juan basin in New Mexico and Colorado. The Black Warrior basin in Alabama was first. The basin with the most number of wells drilled is the Powder River basin in northeast Wyoming. There are many other basins around the U.S., Canada, and the rest of the world. There are commercial coal bed methane projects around world in addition to those three major basins.

How much coal bed methane is there?

A lot. According to the USGS in 2000, the US CBM resource is about 700 trillion cubic feet (tcf), of which they estimated about 100 tcf to be economic. The US consumes about 22 tcf per year, so CBM presents the equivalent of at least a 5 year supply to our country.

World-wide estimates of CBM resources range from 6,000 to 24,000 tcf, with the former Soviet Union estimated to have two thirds of the resource. China's resource is estimated at about 1,000 tcf.

CBM Resource Estimates
Units: tcf Source: Scott, 2004

	Low	High	Pct	
FSU	4000	16000	69%	66%
N.America	950	4400	16%	18%
S.America	15	32	0%	0%
Europe	160	270	3%	1%
Africa	27	55	0%	0%
Asia-Pacific	650	3400	11%	14%
	5800	24200		

Are the coal bed methane resources concentrated or scattered?

There are single huge deposits, and it is also throughout the world, all over the world. A coal basin that has not been degassed will have coal bed methane. Whether it is economically producible is another question.

What is the most exciting thing about the industry?

The vast majority of initial exploration and development activity is done by fairly small companies. The largest companies with exposure to coal bed methane is ConocoPhillips, followed by Marathon and Pioneer. It wasn't until the mid '90s that the industry expanded significantly outside of San Juan and Black Warrior basins. It can be classified as a young industry.

Where is the area with the best CBM potential?

In the Rocky Mountains of North America. The Rocky Mountains are often called the Persian Gulf of natural gas because of the amount of gas contained in unconventional gas deposits, such as CBM, tight gas sands, and fractured shales.

Is there an association of CBM producers?

Not solely for CBM producers. However, the oil and gas industry has several associations in the Rockies, such as Petroleum Association of Wyoming, Colorado Oil and Gas Association, and IPAMS, which do include CBM as well as other producers.

When did CBM start?

It first started in the late '70s and early '80s. A significant amount of research was needed to make it viable, as existing conventional oil and gas technologies were largely incompatible with CBM development.

How long will it be until coal bed methane rivals or outproduces traditional natural gas?

Unconventional natural gas, which includes tight gas sands and CBM, outproduced conventional onshore US natural gas sources beginning in 2004. And, CBM production is now about 25% of the unconventional supply, or about one eighth of the total supply.

What do you look for in a CBM site?

I look for areas that have significant retained or produced permeability. The three most important concepts in defining an economic coal bed methane are coal thickness, gas content and saturation, and permeability.

I look for basins that have extensional tectonics, characterized by normal faulting, wrench faulting, and rifting. Many of the basins in the Rocky Mountains are subjected to substantial compressive tectonic forces, which can be very detrimental to coal permeability. The foreland basins such as Powder River Basin of Wyoming have not seen significant compressive forces, except in limited areas. Other basins, such as the Sand Wash Basin of Colorado and San Juan Basin, have high permeability because of a large wrench fault systems.

The basins of southern Africa have coals that have significant permeability because they were deposited in an active rift basin, and have been subjected to recent rifting and related faulting. Other basins, such as the western Green River basin of Wyoming and parts of the Canadian Rockies have limited potential for CBM production because of the effects of compressional tectonics.

What is a rift basin?

Rift basins are formed where the crust was pulling apart in an active rift zone, which is usually related to plate tectonic activity.

What are the major factors in CBM extraction?

Permeability and coal thickness are primary factors. The third factor to look for is gas content and relative saturation. The capacity of the coal to hold CBM is a function of its rank, and is quantified by its adsorption isotherm. With increasing pressure the coal will hold more gas up to a measured capacity. Economic production occurs quickly when, at a given depth and pressure, the target seam has a gas content either at or very close to the isotherm, which is ‘saturation’. As dewatering begins to lower the reservoir pressure, gas production occurs rapidly. If the target seam is undersaturated at a specific depth,

significant water production must occur to reduce the reservoir pressure to allow gas production to commence. In many cases this can exceed three years. Even then, depending on the pumping and water management costs, CBM production can be economic.

How long does it typically take to see CBM production after a site is found?

It now takes from 3 months to a year and a half to permit and drill a well. Permitting is the big time requirement. Drilling and completion only takes about two days in the shallow Powder River Basin, to a week or so for deeper CBM wells. After the well is drilled and completed, and if the coal is saturated with gas, production can commence in just days to a few weeks. If undersaturated, there may never be any CBM production. That's a function of permeability, thickness, gas content and saturation.

What makes the US the most developed in coal bed methane technology?

The independent oil and gas companies in the US.

Have you been helped or hurt by government policy?

There are currently no regulatory or tax incentives. The industry was kick-started by section 29 of the tax code in the late '80s and early '90s, but today people understand CBM well enough for no government incentives to be required. There are many regulatory disincentives, such as the time and effort needed to obtain drilling and water discharge permits. This certainly slows down our ability to develop CBM, and in places prevents development due to economic impacts of the regulations.

Which Senators support CBM and which oppose it?

Wyoming Senators are for it. Massachusetts and California Senators are against it, despite massive use of natural gas in their states.

There's not been a direct vote on CBM in Washington, but there are plenty of indirect votes in congress. For example, take the votes on ANWR; both Democrats and Republicans have said "no" to developing a resource crucial to our country's energy supply.
Natural gas is also a crucial resource, and my guess is that most of those same politicians that voted against ANWR would also vote "no" to further natural gas development, including CBM.
The politicians and bureaucrats are heavily pressured by the anti-development crowd to vote and say no. The US needs new natural gas and CBM supplies developed in the US. Without that, we will face shortages, unless we're willing to import a lot more liquefied natural gas. A dollar spent in the US on oil and gas production is a dollar less that goes overseas to the Middle East, Venezuela and other energy exporters.

Has the government hurt coal bed methane in any ways?

We have been hurt by the Bureau of Land Management bureaucracy, and by the environmental bureaucracies in the Federal and State governments. Just in the ways we've been able to permit and produce the wells, opposed for specious reasons at best. Bureaucrats have said to us that their goal was to get rid of oil and gas development.

Is coal bed methane the most exciting thing in alternative oil and gas exploration?

Coal bed methane is the most exciting area in independent oil and gas right now. Wells are shallow enough that very small companies can get started into coal bed methane.

One of the companies that I helped found was Pennaco Energy, focused in the Powder River basin of Wyoming, which was subsequently purchased by Marathon. There the average well depth in the first

years was about 800 feet, and within three years Pennaco was producing over 100 million cubic feet of gas per day, from many hundreds of wells.

One of the drawbacks to early CBM development was lack of infrastructure in the Rocky Mountains; this caused the wellhead price to suffer substantially from the 'basin differential'. Since then a number of new gas pipelines have been completed throughout Rockies, opening significant production capacity in Powder River, the Sand Wash basin, and other basins that transfer to these pipelines.

In what ways should coal bed methane appeal to environmentalists?

Compared to developing coal for heating or electricity in the US, CBM has a smaller environmental 'footprint'. This includes the amount of surface disturbance and air emissions.
Overseas, one small coal bed methane well in Africa is the equivalent of 300,000 trees. Coal bed methane helps stop deforestation in third world countries. A lot can be eliminated by one small coal bed methane well, so environmentalists dead set against CBM will like it if they become informed. In Wyoming, Montana, and throughout the US, many environments are against all oil and gas development and they won't listen to reason.

In what ways do you remove both the CBM and the coal from a coal bed?

You remove the coal bed methane and then remove the coal, for example in the Black Warrior basin. Degassing the mines takes place first.

Are there mainly a few large companies doing CBM, or mainly many small companies?

Small companies start the majority of coal bed methane projects, and large firms acquire them. It is very labor intensive, and the overhead of large companies make coal bed methane not viable. Small independent CBM producers might drill 1,000 wells in one year, which is about the number that Shell drills in a year.

Is having the ability to drill more wells a good thing?

Yes, it's essential and necessary. Gas wells have production rates that naturally decline over time, and that decline must be replaced to maintain or increase total gas production. The US consumes about 22 tcf per year, and this is expected to grow to 25 tcf per year within 10 years.

Decline rates depend on the type of gas reservoir; for CBM reservoirs, this can be 7% to 25% per year. In other words, CBM well production rates can be expected to halve every 3 to 10 years, and we have to drill 7% to 25% more wells annually just to keep up with declines from existing wells.

Are there CBM sites all over the world, or mainly in North America?

There are a lot of CBM projects around the world, in Zimbabwe, Botswana, South Africa. Australia, China, India, Indonesia is huge, Columbia, Venezuela. Southern Africa has as much gas as North Africa, it is just contained in coal beds. For example in Southern Africa, coal bed methane could help raise the standard of living in developing nations. The largest cause of lung cancer in developing nations is wood smoke, replacing wood burning fires with clean burning coal bed methane will potentially reduce lung cancer significantly in those countries. Coal bed methane is a resource that is hard to export, it has to be used in the country where it is found, which has a positive benefit in the balance of payments for those countries. Rather than importing electricity in Zimbabwe, it could be self sufficient in electricity. Coal bed methane can also be made into fertilizer. If subsistence farmers in Africa had the fertilizer that they require then famine would be eliminated. Rather than aid agencies pouring hundreds of millions in,

creating infrastructure for coal bed methane has the very real possibility of eliminating famine in those countries.

"The Skeptical Environmentalist" is a good book, it has a couple of good chapters about lung cancer in Africa. It has a quote: "the stone age didn't end because of lack of stones, the fossil fuel age isn't going to end because of lack of fossil fuels."

Why is there not more coal bed methane in China and India?

There is a development scenario called coal mine methane, when there is a gas outburst and an explosion at a coal mine, as often happens in China. The reason for the outburst is that the coal has low permeability so gas cannot escape rapidly enough. Trying to develop coal bed methane in those areas is almost always not economic. Coal mine methane drainage is typically done with horizontal holes drilled inside the mine, underground. It is very rarely economic for the coal mine, based on gas sales alone.

What factors will increase independent gas production in the future?

Tight gas and fractured shale technology is coming and will be big. The most exciting thing is that a small startup company can be very successful with coal bed methane. You're not spending $2 million per well, you can spend $500,000 per well, in the Powder River if everything goes right it's $150,000 per well. There is a low cost of entry, but if you don't know what you're doing it can get out of control, that's why some companies in Powder River aren't making money.

Could you talk a little about shale oil?

The Bakken Shale of Montana and North Dakota is the current ‘hot’ play for shale oil development and production. The Bakken Shale has been a tremendous oil source, with estimates of over 400 billion barrels of oil generated. Within the Bakken, there is a zone that has greater quartz content and porosity, which tends to develop fractures and is the oil reservoir. Horizontal wells are drilled to cross these vertical fractures, and can produce over 1000 barrels per day as a result. In one area of Montana, initial productions from horizontal wells average over 400 barrels per day, plus 400 mcf gas per day.