Critical success factors of CBM development - Implications of two strategies to global development

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Abstract

The US currently gets almost 30% of its gas from unconventional resources and CBM makes up 10% of this, with projections of strong future ramp up. One strong indicator is drilling activity for CBM, which is rapidly growing in the U.S and Canada. In 2007, it is estimated that there was 20% increase of CBM completions in the North America. This helps make the US one of the leaders in CBM and a model for other countries hoping to develop CBM. The North American model exists due to the extensive infrastructure; strong gas prices, strong demand and a declining conventional resource base.

Outside of the North America, another key region for CBM is Australia. The country contains about 30 coal-bearing basins, mostly Permian and Mesozoic in age. Based on IHS data, proven reserves in Australia have been estimated at about 10 tcf of gas. Adequate exploration efforts can potentially increase this number to 100 tcf level.

However, the two locations are very different from a business model or strategy stand point. In North America, the CBM business is run by traditional oil and gas companies. To monetize the production, CBM producers utilize exiting gas transportation systems and distribution networks. They compete with other sources of supply. While in Australia, the power market and lack of alternatives drive the need from CBM. A typical Australian CBM project is led by a power generation company who moves upstream only to get fuel for power and energy. This tends to be an integrated effort with the company involved in the CBM well site, water management facilities, a 100 km gas transmission pipeline, and the power generation plant.

A review of the global database of potential and other active CBM plays indicates that these two strategies/models are applicable in other areas and could also provide some guidance into development of new areas.

Introduction

Recent coal bed methane (CBM) success in North America has been due to six critical success factors. Outside of the North America, Australia has perhaps the most commercially advanced and rapidly growing CBM industry. In Australia some of the U.S. success factors exist however due to the remoteness of this coal dominating region and lack of conventional gas resources a different business model applies. The Australian business model is mainly driven by local and regional energy needs, particularly for power generation in areas separated long distances from conventional supply. Local power needs in Queensland have lead to fast rise in CBM production and reserve growth. Our estimates indicate about 10 tcf of proven and probable reserves have been reported so far.
Almost every continent now has CBM projects underway or evaluation. Most follow the Australia model. However favourable geological factors such as occurrence of thick gas-rich coal seams at shallow depths, with good fracturing; and low ash content do not necessarily coexist with an ideal business environment. Government regulations on the environment also hinder some development. Still many countries like India, China, Indonesia and Poland see CBM as a strong alternative to conventional supplies and are offering incentives to CBM investors. These are needed most in emerging countries where gas prices traditionally have been too low to support investment. And several countries like Indonesia are currently preparing new legislation regarding the exploitation of CBM. In this study we will look at several of the other emerging CBM areas and compare them against the US and Australia models and see if they fall in either group.

Data Source and Acknowledgements

For information, we have relied on the extensive datasets from IHS which includes it Upstream and Coal subsidiaries. We have also utilized IHS proprietary software and tools GEPS™ and PEPS™, and EDIN™, Enerdeq™. We would like to thank IHS management for their permission to publish the results of this study and our colleagues David Reimers, Pete Rushworth from IHS who contributed to this paper.

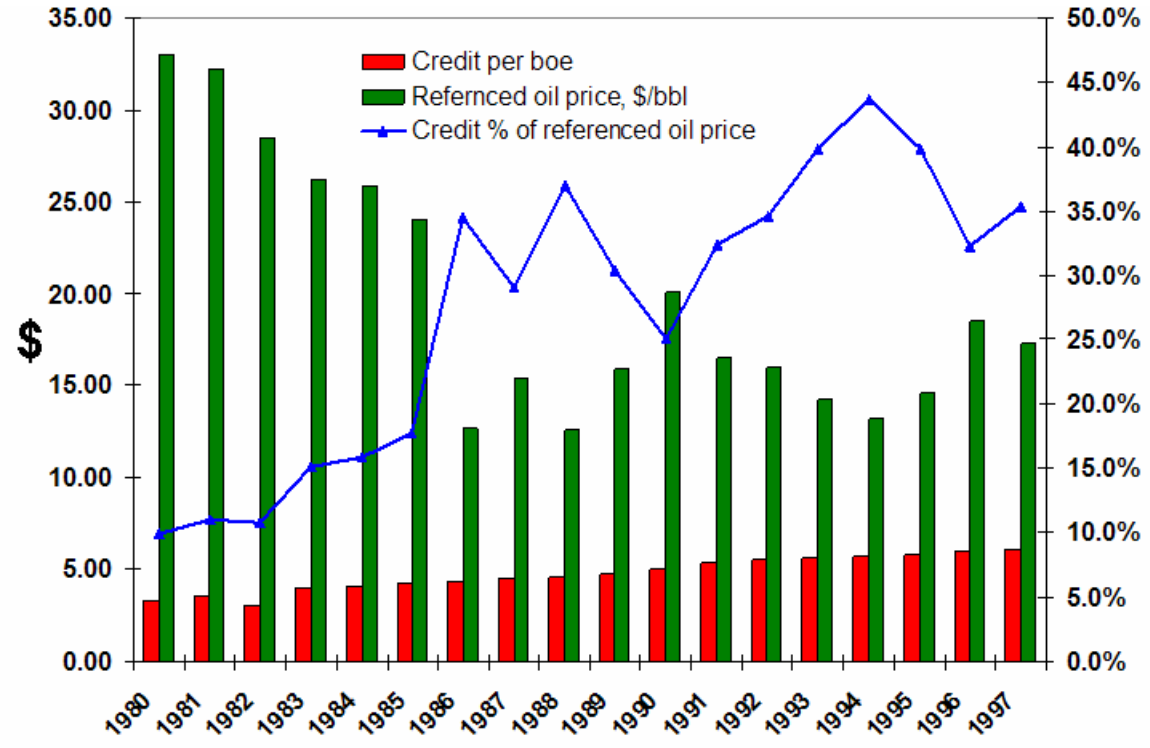
U.S. Business Model

The Drivers
The source of gas supply in the US is changing rapidly as traditional reservoirs begin to decline. CBM is one of the leading new sources and activity continues to ramp up. In 2007, of the more than 30,000 gas wells drilled in the Lower 48, CBM wells made up almost 6500 or almost 20 %. In terms of production, CBM accounts for about 10% of total gas production in the US but this number continues to grow.
In this study, we have identified six critical success factors for CBM development in the U.S.: (1) abundant coal basins, with thick coal seams, high gas content and suitable reservoir characteristics. USGC estimate CBM potential reserves in the U.S. at a level of several hundreds tcf of gas; (2) significant tax and fiscal incentives in initial phase of CBM development history; (3) historically strong and deregulated domestic gas prices; (4) open and extensive gas distribution network; (5) little competition from declining production of conventional gas and growing market demand; (6) a strong entrepreneurial approach to applying new technologies.

First Wave of CBM
Gas from coal has been around for centuries but significant modern exploration and development of CBM started as a result of the “Energy crisis” in the 1970’s. In April 1979, President Carter announced that he intended to phase out oil price controls implemented during the 1970’s Energy Crises by September 30, 1981. However, it was to be replaced by the Crude Oil Windfall Profit Tax Act of 1980 and Internal Revenue Code 29(a) or Section 29 tax credit. Buried in Section 29 was a clause inserted to help spur investment in alternative energy sources, one of which was CBM (Greg A. Sanderson and Lesley W. Berggren, 1998).The concept was simple, to divert cash from taxes levied on conventional fuels to use for the promotion of non-conventional fuels. Many states mimicked the concept of Section 29 by relaxing taxation, usually in the form of reduced severance taxes. For example, in Texas

there was a tax exemption for High-Cost Gas wells spudded or completed between May 1989 and September 1996. From 1980 to 2002 Section 29 Tax Credit provided huge incentive to CBM producers as shown in Figure 1, encouraging production of alternative sources and making them competitive in the market. This rings a familiar bell to discussions currently underway but this time the winner is alternative energy.

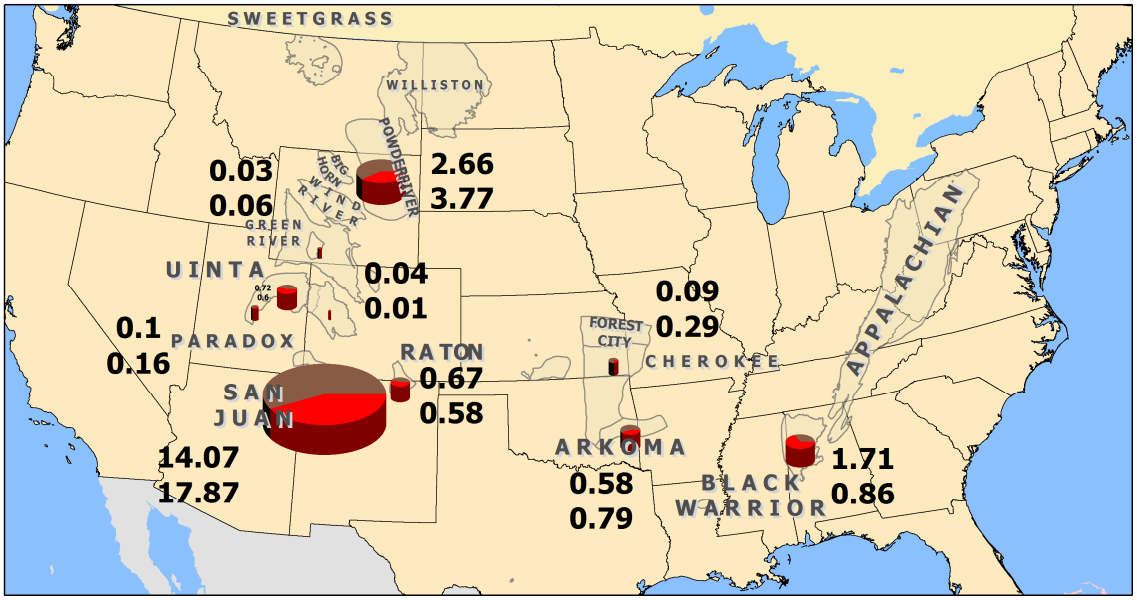
Figure 1. Value of Section 29 Tax Credit and Referenced Oil Price



The Big Two—San Juan and Powder River

About 80 percent of coalbed methane production in the United States comes from the Rocky Mountain region. The major producing basins are the San Juan Basin in Colorado and New Mexico and the Powder River Basin in Wyoming and Montana, followed by other basins in Colorado, Utah, Alabama and the Virginias as shown on a map. (Figures 2 and 3)

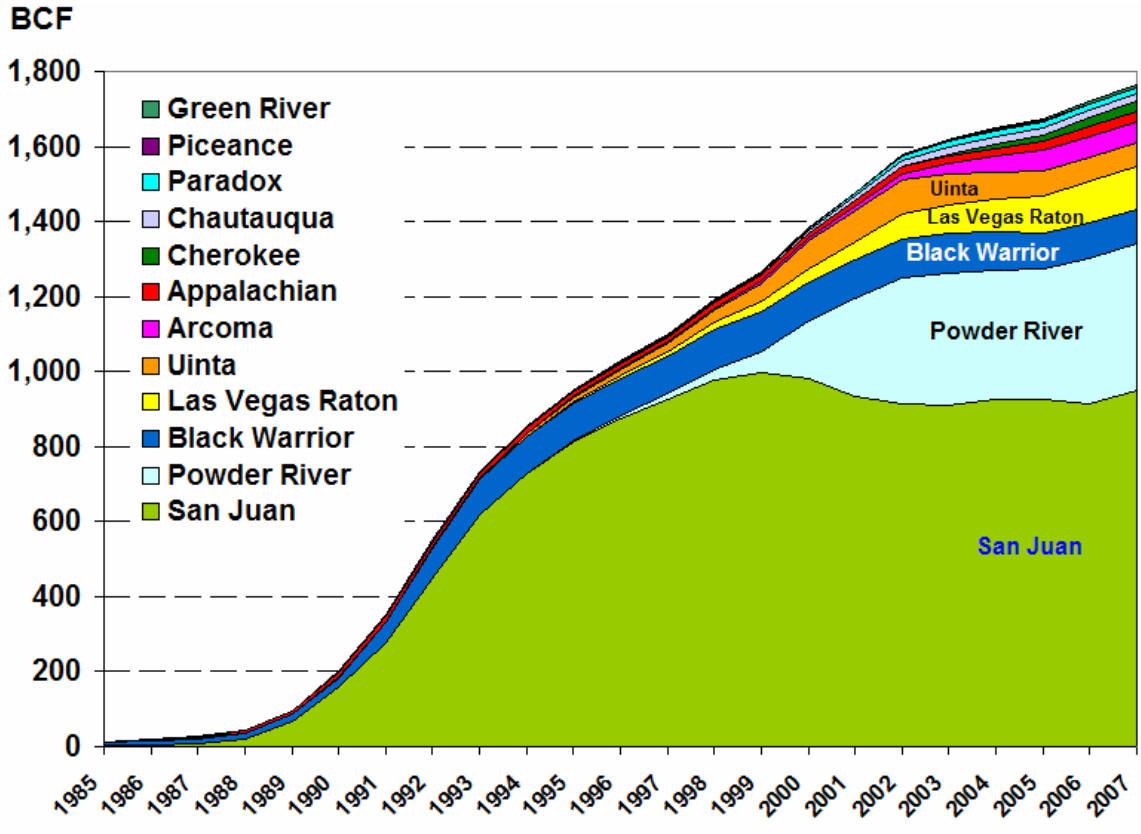
Figure 2. Relative cumulative and remaining production* in CBM basins, TCF.



* Red represents cumulative production and brown represents remaining production, tcf

The Powder River Basin is a great source of thick mineable low rank coal. This coal is saturated with biogenic gas and the gas content is only 30 to 70 cubic feet per ton of coal, versus that of thermogenic gas which averages 300 cubic feet per ton of coal that is seen in many other basins including San Juan. The Powder River coal seams are very thick (up to 60 meters), and are very close to the surface. The average well in the basin is about 330 meters deep. Typical CBM Powder River well costs range from $75,000 to $200,000 versus the average $275,000 for San Juan Basin well which is slightly deeper (500 m). (Megan Sever, 2006). Typical well rates range from 200 mcf in the Powder River to 700-1000 mcf in the San Juan.

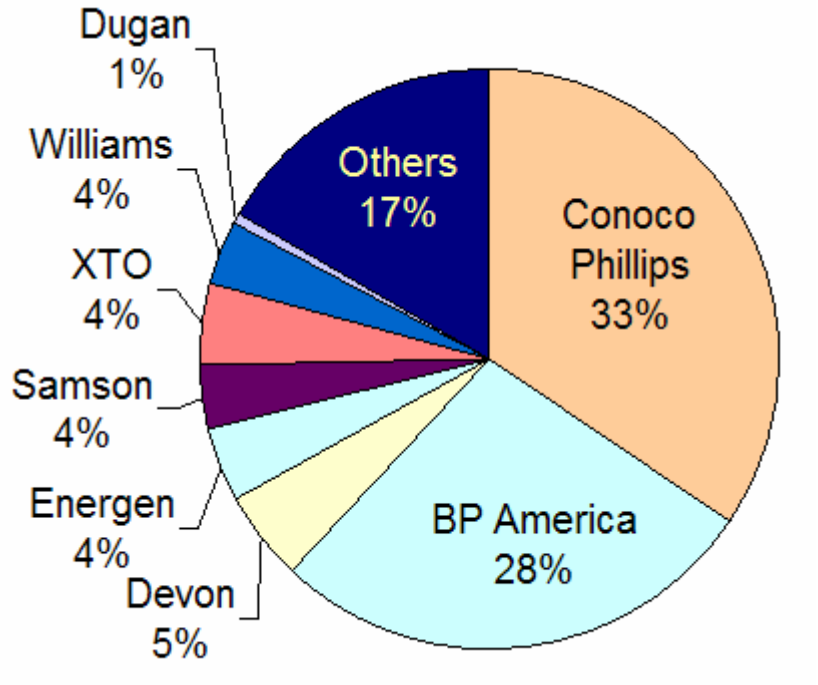
Figure 3. CBM production history by basin in the U.S.



Operator Evolution vs Basin Maturity

The San Juan Basin has had a long history of both conventional exploration and production as well as CBM and hence makes for a good case study of the evolution from initial exploration of CBM to its current status as a major producer. Activity in CBM started In 1977-78 when Amoco began a pilot program. In 1980 this accelerated with the implementation of Section 29. This resulted in additional operators joining the play. From 1980 to 1984 more than 30 operators (mainly small independents) initiated drilling programs. From 1985 and 1992 (window for Tax credit was closed) more big and middle size independent companies came to the area including Arco, Meridian Oil, Phillips Petroleum along with many smaller players. But a downturn in gas prices and low recovery rates curtailed activities from 1993 to 2000. However despite the unfavourable market condition, eighty three small and big operators drilled about 1200 CBM wells during this period. Meridian oil and Amoco were the leaders among the original players followed by new players such as Burlington Resources, Conoco and, Devon. With price recovery and some new completion techniques drilling activity picked up significantly in 2001 with about 3,300 drilled since 2001 by more than a hundred operators. The top ten companies are: Burlington, BP, ConocoPhillips, and several smaller independents like Dugan, XTO, Williams. (Figure 4) But some on the heals of this activity increase came a series of mega mergers as companies sought to become more efficient and build bigger US gas positions. The result was dominance in the basin by ConocoPhillips and BP (Burlington /Meridian/ ConocoPhillips and, BP – Amoco,) and six others as shown on the chart below. These eight produce 83% of the total production within the basin (2006 data).

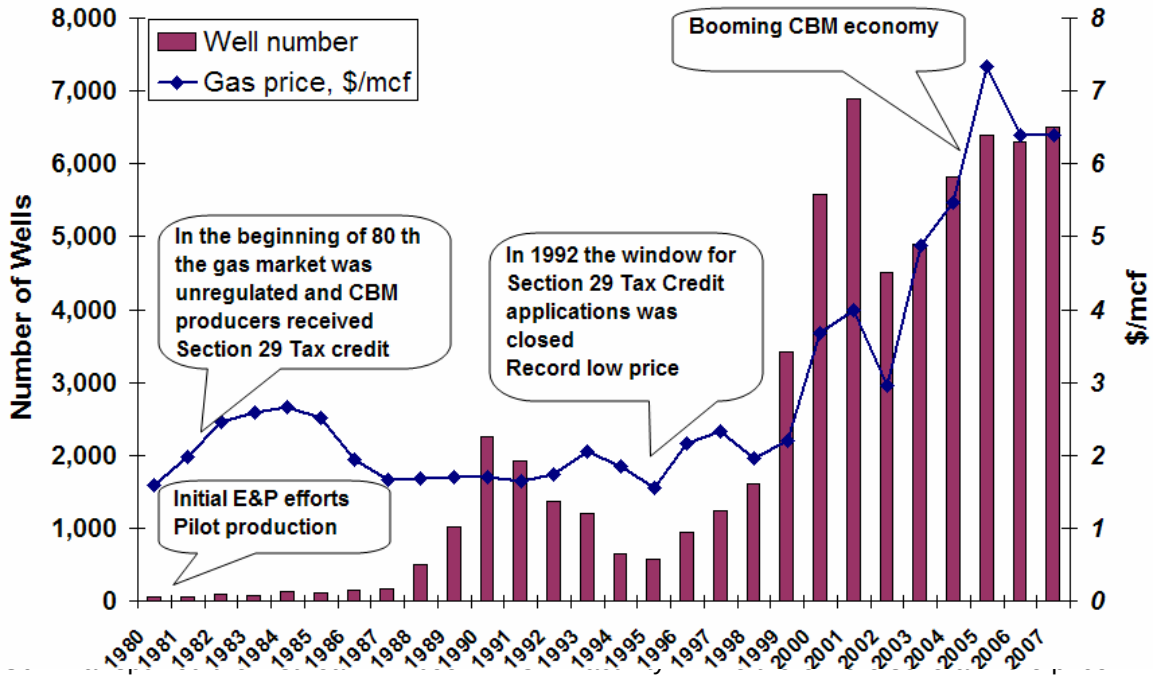
Figure 4. CBM production by company- San-Juan Basin



The Role of Prices

CBM and natural gas activity is very sensitive to price. This can be seen by looking at a chart of CBM activity vs gas prices. In 1970's gas prices were regulated by the U.S. government and traded in a band from from $0.20 to $1.18 per mcf Not surprising little to no CBM activity occurred. Deregulation of the gas market in the U.S. in the late 70's resulted in price growth in the beginning of 80's and this along with Section 29 resulted in the first CBM activity

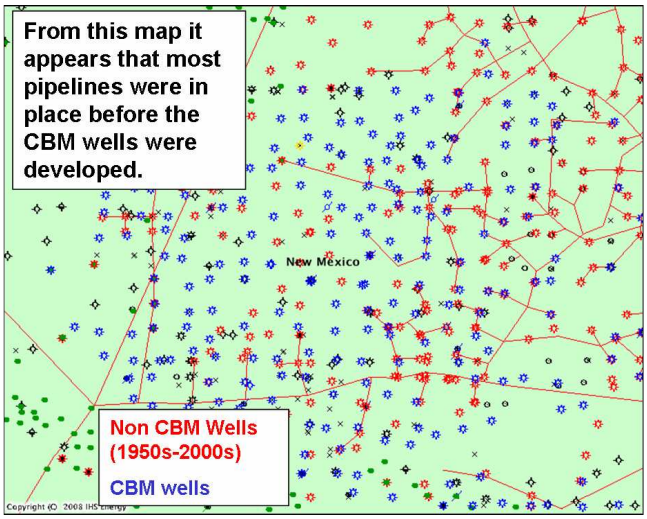
Figure 5. Wellhead price and CBM drilling statistics in the U.S.



downturns since the mid 90's activity has been growing, with current CBM drilling in the US at more than 6000 wells per annum. (Figure 5)

Infrastructure and a dense distribution network.
An additional key factor which helped CBM to succeed faster in the U.S. was the large existing infrastructure and dense distribution networks which were built for delivery of conventional gas. Note the map below, which shows the extensive pipeline network in the San Juan Basin. Many of these lines where in place before CBM wells were drilled. (Figure 6)

Figure 6. Western San Juan Basin

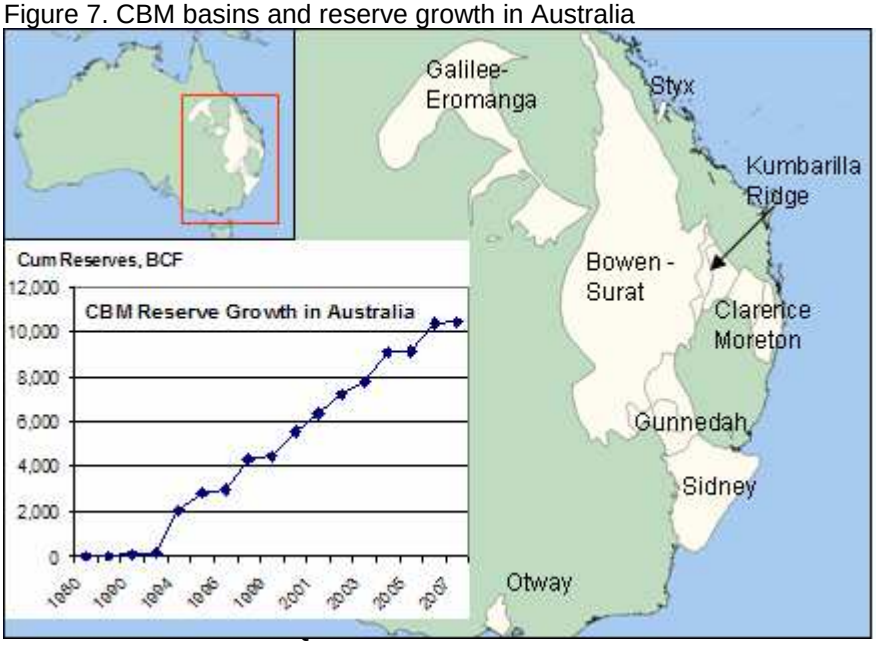


Australian Business Model

The Size of the Prize
Australia is the world's fourth largest coal producer and the world's largest coal exporter. Outside of North America, Australia has the most commercially advanced and rapidly growing

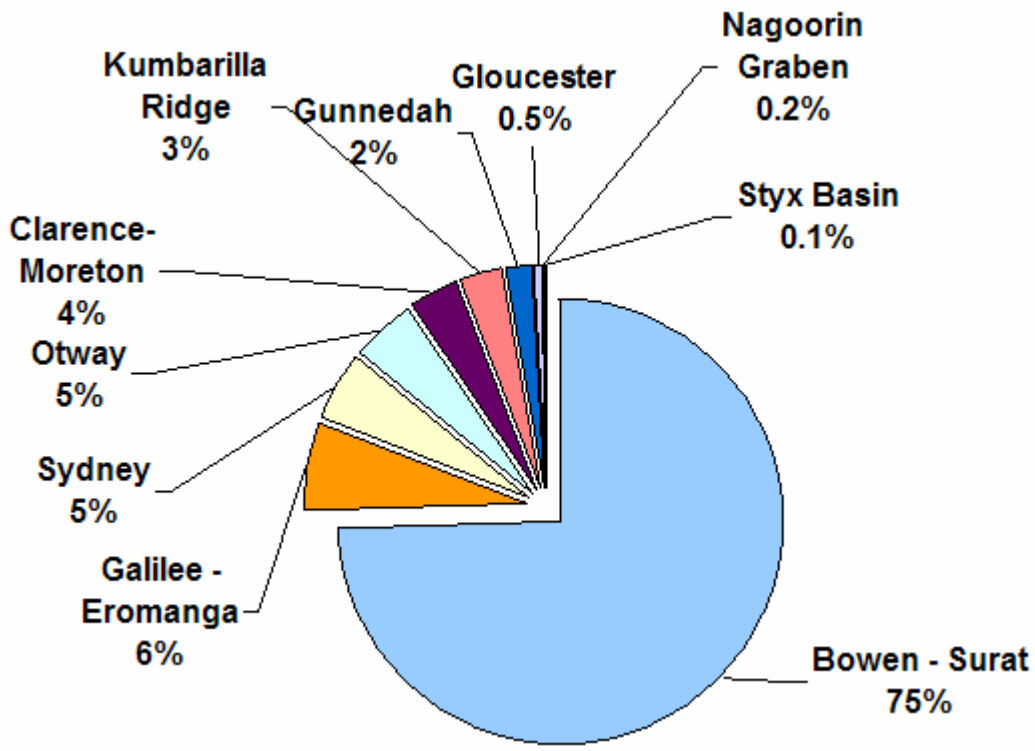
CBM industry. The country contains about 30 coal-bearing basins, mostly Permian and Mesozoic in age. (Figure 7,8)

Figure 7. CBM basins and reserve growth in Australia



ıstralia, primarily in ın Gas Association (Gas Statistics Australia, 2002) estimates that total Australian resource CBM is about 220 tcf, which is considerably greater than discovered conventional gas reserves of about 140 tcf. Our data and analysis indicates, proven plus probable reserves in Australia of nearly 11 tcf. In 2007, CBM production in Australia reached a production rate of almost 100 bcf/year.

Figure 8. CBM reserve distribution in Australia

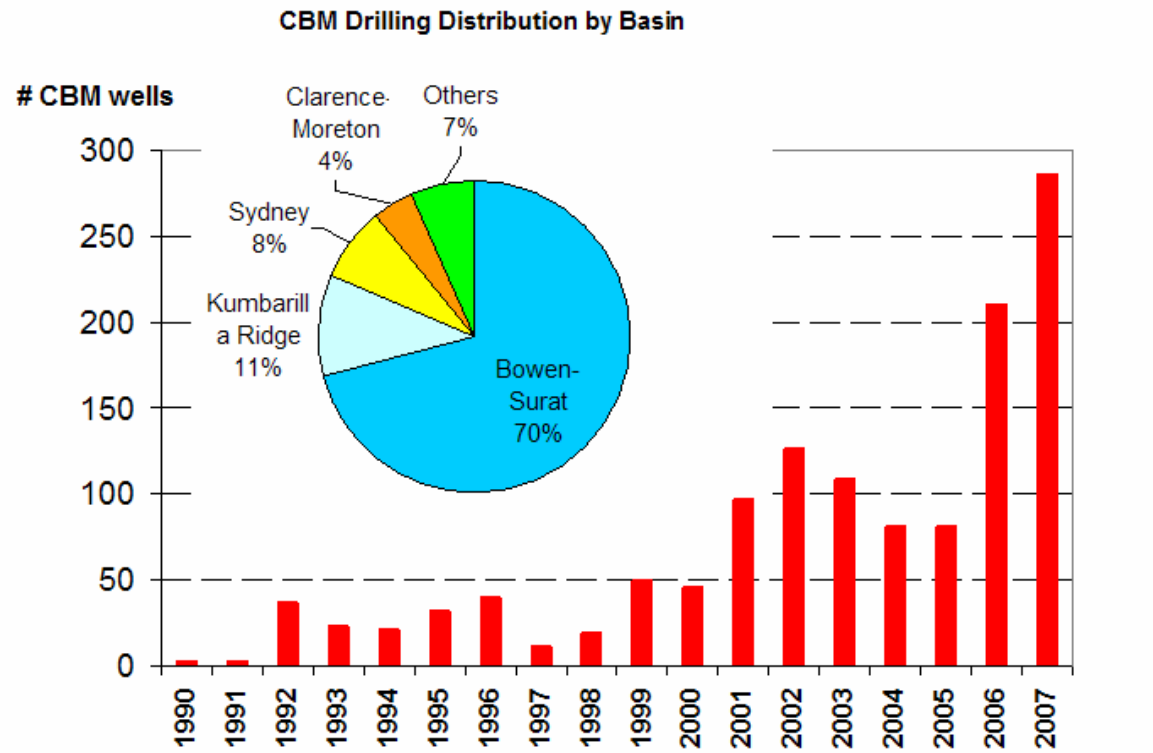


Leaders

The most successful CBM producers are local small E&P players-- Origin, Tri-Star, Eastern Gas, Anglo Coal, Capricorn. Increasingly, larger companies, such as Santos and Origin are aggressively acquiring CBM reserves through mergers and acquisitions. Among the top five current owners of CBM reserves are Origin, Santos, Arrow Energy, Queensland Gas and AGL. Three of them are directly involved in power generation and retail (Origin, AGL and Queensland Gas). During the last two years, CBM drilling rates in Australia jumped to almost 300 wells per year from less than 100 in 2005. Most of these wells were drilled in the Bowen Surat, Kumbarilla Ridge and the Sydney Basins (Figure 9). CBM is also expanding to the west of Australia, with new exploration blocks recently awarded in the Perth Basin.
Another strength of Australian CBM producers is their ability to keep their costs low. Based on published data (SunShine Gas) finding costs for Jurassic produced CBM is about 0.4$/mcf and average development and operating costs are expected to be around $1/mcf.

The Model and Market Drivers
Historically, the Australian energy/ power market was coal dominated and natural gas prices were held in check by low coal prices, as well as lack of alternative markets due to distance. Until recently these prices ranged from $1.5 to $3/mcf.
Several factors are currently pushing Eastern Australian gas prices up: rising energy demand on the back of industrial growth, the environment debate and changing government legislation, and the decline of conventional production in Cooper Eromanga basin. Moreover and perhaps more importantly, new marketing alternatives via LNG are arising: Australia's leading CBM producer, Queensland Gas Company (QGC), recently announced an alliance with BG Group to build a world scale LNG plant on the Queensland Coast using CBM gas as feedstock. This will unlock much more of the undeveloped gas which to date had been used purely for local demand. Santos also has proposed building an LNG plant. The Gladstone LNG project would start with capacity of a 3-4 million tones per annum.

Figure 9. CBM drilling statistics in Australia



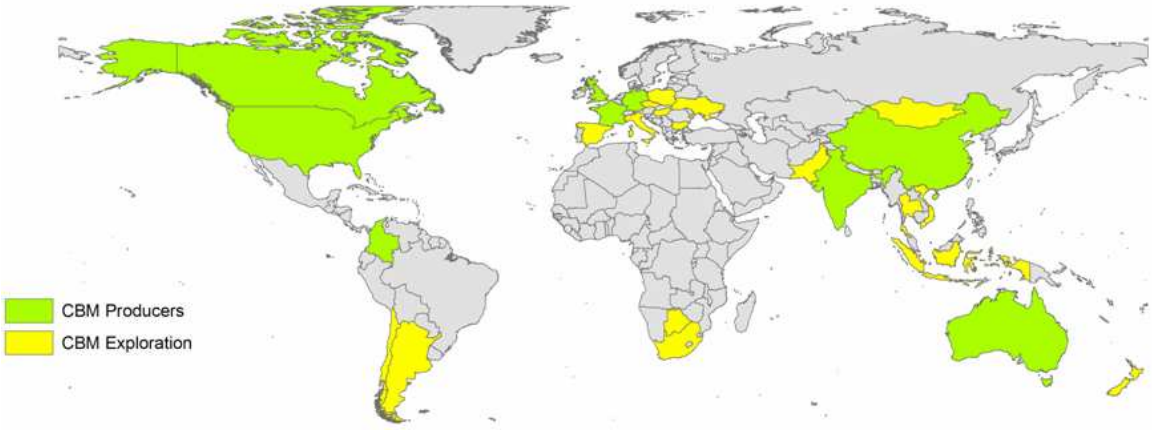
Recent environmental legislation and Australia's adoption of the Kyoto legislation is also driving the increase in CBM activity. In the eastern part of Australia (Queensland, New South Wales) CBM is replacing coal as the fuel of choice for power generation. Gas power plants

create less than half the green house gas emissions than equivalent coal-fired power stations. New state of Queensland legislation requires 18% of electricity generation to be gas sourced by 2020 to reduce green house gas emissions. The changing energy profile is accelerating the push to fuel integrated generators and retailers (Origin, AGL) to move into E&P business. They are aggressively acquiring exploration areas and other CBM acreage holders as they seek to develop and produce additional CBM reserves. In addition, traditional exploration companies (Arrow Energy) are starting to buy ownership in power generation plants.
Both power generators and traditional E&P companies are still sticking close to home as they acquire only significant CBM acreage close to existing gas and electricity infrastructure and markets. And in much the same way as other new entrants in a basin or play try and fund expansion or higher risk activities like exploration via production, CBM players are doing the same. Many start initially with a small-scale power station to kick-start CBM production, and then they begin expanding as demand for power generation increases. This model allows companies to deepen the integration within their business across the competitive segments of the energy supply chain; to more effectively manage risk associated with fluctuations in wholesale electricity or gas prices; and create opportunities for growth but in a controlled way.
The majority of CBM supply agreements in Australia have been signed with individual power stations, many of which are sited near or at the CBM project. Current gas prices range from $2.8/mcf to $3/mcf. A typical CBM development with capacity of 35MMcf/d requires AU$200 million to: drill 50 CBM wells, build water management facilities, construct a 100 km gas transmission pipeline, and build an expandable gas processing plant.
In Australia not all of the U.S. success factors can be unconditionally applied. The Australian business model is mainly driven by power generation and environmental regulations rather than strong prices, incentives or existing dense infrastructure network.

Global Application of Two Business Models

Strong demand for both oil and gas is pushing nations to speed up CBM exploration and production. However in many countries favourable geological factors do not necessarily coexist with suitable business environment. Governments or state monopolies controlling low gas prices, lack of infrastructure and strong competition from conventional gas put a huge barrier for CBM development. In this paper we identified those countries that have either existing CBM production (full scale or pilot) or potential to commercialize CBM. (Figure 10)

Figure 10. Global CBM developments



Many of these countries are offering fiscal incentives or slightly better terms to companies involved in the CBM business. Poland, for example, offers favourable fiscal conditions (no royalty, no state participation, income tax at 19%). The Indian CBM contract contains encouraging provisions for CBM developers - no signature bonus, no custom duties required for CBM operations, and a tax holiday on income tax for the seven years following commencement of commercial discovery. Others plan to use incentives to stimulate their

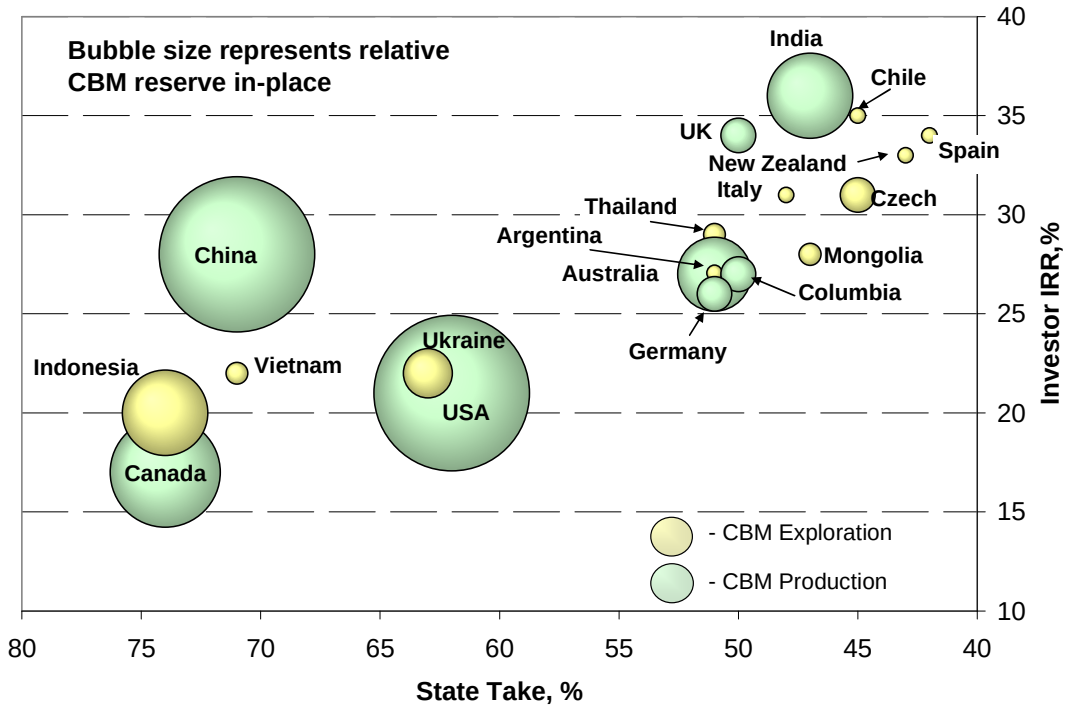
nascent industry. Indonesia is planning to offer contractors an "attractive split" for exploration and development of CBM in the coal-bearing basins of South Sumatra and Kalimantan. And recently China has entered the game in order to speed up commercialization, introducing fiscal incentives and tax subsidies, including exemptions from corporate income tax, resource tax, value added tax and import duties.

Still there are some countries/ basins more attractive than others so we used our modelling to build a comparison of their commercial attractiveness. To do so we modelled a hypothetical 60 bcf CBM development using the fiscal regimes of some select key countries on an after tax basis. The picture below shows the relative ranking of countries based on Investor rate of return (IRR), and state take (state share in total profit). As shown in Figure 11, there is a wide range of after-tax economics in the countries of our focus. In some countries such as Ukraine, Indonesia and Vietnam, it would be difficult to launch CBM exploration and production under current standard fiscal terms.

Europe is on the other hand is one of the more favourable regions for CBM development due to the strong energy demand, high unregulated gas prices and existence of dense infrastructure. In UK, Germany and France CBM is being successfully produced at a small scale. Eastern European countries including Poland, Romania, Ukraine, and Bulgaria have a long history in coal and they are promoting CBM exploration. Both the US and Australia business models can work well in Europe. Water waste disposal and recent environmental regulations provide some challenges.

In some parts of Asia, South America and South Africa demand is growing, however, gas prices are too low to stimulate the industry unless some fiscal and finance incentive are given. In addition many of these regions suffer from too much government control, competition from coal, and limited market access. Still in several of these countries we are seeing power markets just as in Australia driving the way forward.

Figure 11. CBM project economics in selected countries. Assumption made: Reserves-60 BCF, Development cost - $1/MCF, Gas price - $4/MCF



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