NORTH AMERICAN SHALE GAS INDUSTRY PERSPECTIVES RISKS AND CHALLENGES VERSUS OPPORTUNITIES AND GAINS

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Abstract

Production from unconventional gas reservoirs specially shale gas, has been prevalent in North America for several decades and is becoming increasingly important in Australia, Europe and the Asia Pacific region. The U.S. Energy Information Agency predicts that unconventional gas will represent 56% of U.S. natural gas supply by 2030 from 27% in 2000, led by increases in shale gas production. In Canada, production of unconventional natural gas resources is expected to rise dramatically and shale gas alone could reach 1.7 billion cubic feet per day by 2020. Although, the success of unconventional development in North American natural gas supply is contingent on the interplay of technology, cost , recovery, maximization , environment and natural gas prices so this paper will examine current challenges and risks, and difficulties still remain in developing, producing, transporting and marketing gas unconventional fields too and practical options for overcoming them will provide. Challenges include : Natural fracture identification, open hole horizontal fracs and shallow fracture containment ,fluid management-handling large volumes of frac water tainted with drilling fluids and norm, Using shale-reactive fluids ,choosing correct cements – foamed, acid-soluble high recovery cost, reservoir / fluid compatibility (drilling and frac fluid), to cater for the unconventional gas business dynamics, there is a need for a new set of fiscal regimes and environmental concerns for sustainable development. opportunities include: vast unconventional resource of more than 32,000 Tcf (reserves are more than double of conventional gas), key consuming countries to reduce dependency (key proponents are countries with limited/depleting conventional gas reserves),ready market connected by developed infrastructure will expedite development ,there is a higher likelihood of developing unconventional gas within countries with mature or limited conventional gas reserves, North American success validates the resource opportunity (shale gas resources ~40,000 wells ,~1,200 tcf recoverable shale gas),as challenges have been overcome and reserves monetized:1-wide spread resource base can be accessed with established, yet continually improving, technologies 2 - some cost uncertainly vs. exploration and subsurface risk 3-barnett success results in the commercialization of new shales that are forecast to be even larger contributors to supply,4-supply growth in North American has been a key factor in driving down expected LNG imports. Observing financing and investment options for the growing shale gas developments as well as the most cost effective manner to maximizing return on investments. economic drivers and business models that can lead to successfully and how can costs be driven down further to maximize the commercial potential of shale gas in North America analysis will.The price of natural gas depends on supply and demand. In recent years, pipeline imports of natural gas from Canada have helped to hold down US natural gas prices. price is also affected by availability of pipelines and by competition with coal and petroleum.US gas prices of $4/mmbtu (~€10/MWh) indicate that development, drilling and production is competitive, Europe estimates indicate that economical breakthrough requires gas prices above ~$10/mmbtu (€25/MWh), European gas forward prices (NBP) currently at (€13/MWh) for 2012 (~$5/mmbtu).examining the effects of global gas pricing to the growth of shale gas and conclusion that : Gas prices remain lower due to global gas supply glut (below $6 per MMBtu (real 2009 dollars) for the next 20

years).impact will shale have on global markets if it is developed all over the world, Analyzing the impact of shale gas in the USA / Canada and the developments in Asia and came to the conclusion that Asia will become the hottest Market for shale gas will be. Considering potential for unconventional gas is ~7 times higher in North America than in Europe and it enjoys great potential for export to Europe market therefore, we investigated crucial variables for North American companies to enter the European market.

Introduction

Unlike its oil requirements, North America's natural gas needs are supplied almost entirely from domestic production. In 2008, 77% of North American natural gas supply originated in the United States, a further 22% came from Canada, and 1 % was supplied through imports of liquefed natural gas. This self-suffciency in natural gas supply is an important element in North American (energy sustainability) and security. North America's natural gas supply composition is currently undergoing a dramatic shift from conventional towards more unconventional gas sources such as tight gas, coal bed methane (CBM) and, most notably, shale gas. this emergence of unconventional gas is the result of technological advancements in drilling and production that have allowed for the economic extraction of unconventional gas resources. the growth of unconventional supply comes at an opportune time as existing conventional gas plays are becoming smaller and less economic to develop.commercial success depends on finding the right rocks and applying the right technology. The application of horizontal well technology with advances in hydraulic fracturing has opened up significant new resources in these brittle rocks and added material volumes to the natural gas supply in North America. Shale gas developments represent material resources, with production in excess of 1 bcfd in most successful plays. Successful development requires the integration of many disciplines, each with their own specific technical challenges. The economics of these plays continue to improve through the application of technology and by incorporating learnings along the way.Field developments will take decades, requiring billions in investment and posing significant challenges to existing or newly built infrastructure to get the gas to market. However, the commercial variability across the plays is quite large, resulting in winners and losers. The winners will find the sweet spots, apply the appropriate technology and strive to continuously improve over time. Deep shale gas drilling and hydraulic fracturing uses a small amount of water compared to other uses, and does not represent a long-term commitment of the resource. In large measure this expansion is possible because of significant advances in horizontal drilling and well stimulation technologies and refinement in the cost-effectiveness of these technologies. 'Hydraulic fracturing' is the most significant of these new technologies. whether shale gas is able to provide such benefits, however, depends on a number of factors including the greenhouse gas (GHG) intensity (or carbon footprint) of the novel extraction process required in the production of shale gas and how this compares with other primary energy sources (such as natural gas or coal). As an unconventional source of gas, requiring additional inputs and processes for different rates of (gas) return, it cannot simply be assumed that 'gas is gas' and that the GHG intensity of (unconventional) shale gas is similar to that of (conventional) gas and, by the same token, significantly less than fuels such as coal. This is an aspect that, to date, has not been considered in detail and, accordingly ,it is not immediately clear what the impact of a switch to unconventional shale gas will be on GHG emissions. economics of shale gas there are fundamental differences in the production of gas from shale and gas produced from other unconventional sources. Many tight gas sands, for example, yield a tremendous amount of gas for the first few months, but then production declines significantly and often becomes uneconomical after a relatively short time. shale gas is completely different. Shale gas wells don't come on as strong as tight gas, but once the production stabilizes, they will produce consistently for 30 years or more. suppose that new horizontal wells in a typical shale gas play produce 1 million ft per day (1 MMcf/d). If the operator puts 10 such wells on 1 square mile,that section will produce 10 MMcf/d with an estimated 120 bcf of gas per square mile in the ground, these gas shale reservoirs will be producing gas for a very long time. that realization, plus increasingly effective horizontal drilling tools,3D seismic imaging, and advanced reservoir modeling software .Medium and large independent oil and gas companies are showing the most interest in shale gas. v ery small producers with only a handful of wells may have a difficult time acquiring enough acreage to be profitable in shale. unconventional gas is now the dominant source of U.S. Natural Gas production, the 20 Bcfd growth in unconventional gas production has more than replaced declines in U.S. conventional onshore and offshore production. Production of shale gas has grown by ten-fold and is expected to exceed 12 Bcfd, equal to 20% of U.S. natural gas production in the year 2010 . gas shales have changed the outlook for U.S. natural gas from fears of impending scarcity to expectations of plenty. instead of declining, U.S. natural gas production increased, from 53 Bcfd in 2000 to 59 Bcfd in the year 2010.gains in unconventional gas production of 20 Bcfd more than countered declines in onshore and offshore conventional gas.shale gas provides 12 Bcfd today (20% of domestic natural gas production) and accounts for much of the 20 Bcfd of the growth. [Figure1] .currently, the scarcity of shale gas plays outside of the USA may be due to uneconomical flow rates and extended well payouts rather than to an actual absence of productive shale-gas basins.[Figure2]. However, the experience gained in US basins will inevitably help operators around the world exploit shale resources as production from conventional resources reaches maturity.

Technology gains and trends

Much of the research for the recovery of shale gas is focused on more efficient ways to fracture the shale. Fracturing is the key to a successful shale gas well. Many of the new deeper shale gas wells are horizontal, and the cost of fracturing them can be as much as 25 % of the total cost of the well. operators must determine the payoff for spending the money to fracture more of the reservoir .they then set a plug, move up the wellbore, perforate, and repeat the process. each move is one stage. Ideally , the well should be fractured in as many stages as possible, but the cost would be prohibitive. operators typically pump a stage, using from 2 to 4 perforation clusters for every 500 ft of lateral section. the problem is, with a 2,000-ft lateral and only 4 stages, there are just 8 to 16 zones of entry. that leaves almost 90% of the rock untouched. One hot area of shale gas research is seeking ways to complete the greatest number of stages as cheaply as possible in a horizontal well. ideally, the best scenario would be to pump 40 or 50 smaller stages, putting the fractures as close together as possible, but that is not practical and far too expensive with current technology. current thinking is that the fractures should grow out at right angles, away from the wellbore. most shale gas wells are designed that way. It's possible that one large longitudinal fracture may be just as good and more cost effective than multiple transverse fractures. reducing land use impacts with multi well Pads and horizontal wells, multi well pad drilling reduces land use impacts and rig mob/demob time, also operators can save $100,000 to $200,000 per well by using multi well pad drilling.

Shale Gas and Unconventional Gas Impacted Natural Gas Prices

Price and technology also play major roles in determining the amount of natural gas that is pumped, much more than we think of with oil. The price of natural gas depends on supply and demand. Natural gas is fairly plentiful around the world. while it is difficult to ship natural gas, there are indirect ways the foreign natural gas can compete with US natural gas. chemical industries can move to cheaper sources of natural gas. also, products like fertilizer can be made abroad and shipped to the United States. In recent years, pipeline imports of natural gas from Canada have helped to hold down US natural gas prices. Price is also affected by availability of pipelines and by competition with coal and with petroleum. Historically , the price of natural gas has been highly correlated with that of oil (R squared = .82 for 1986 to 2007, comparing the wellhead price of gas with the price of west texas Intermediate (WTI) oil.) on Figure 3, will be showen the wellhead price per 1,000 cubic feet of gas and an estimate of the price of gas equal to 10.9% times the WTI oil price per barrel. Figure 3 and 4 shows annual averages for he years 1994thorough 2010. for 2008, the amounts reflect recent May 2008 prices (WTI=125.83; natural gas = 11.71). Recent natural gas prices seem to be lagging behind their historical relationship with oil, leaving some room for natural gas prices to rise. unconventional gas (particularly the higher quality gas shales) is today the low cost portion of the natural gas price/supply curve [Figure4]. projected wellhead natural gas prices AEO 2010 versus AEO 2011(early release overview), [Figure6]. The incorporation of a more complete representation of U.S. shale gas resources in the U.S. DOE/EIA Annual Energy Outlook 2011, dramatically lowered projections of future natural gas prices. The latest projections (AEO 2011) show natural gas prices remaining below $6 per MMBtu (real, 2009 dollars) for the next 20 years. Short-Term Energy Outlook, September 2009With essentially no limit on the domestic supply of gas for several decades, at $6/M BTU operators can make money, utilities can save money and CO2 emissions can be significantly reduced.[Figure7, Figure8]

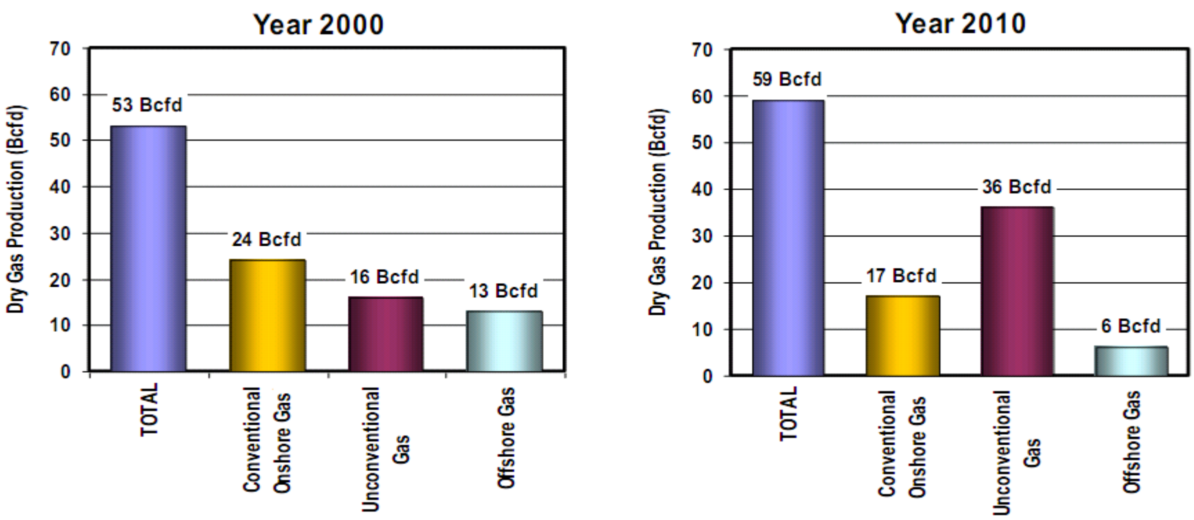
Shale Gas: Challenges and Opportunities

Looking forward, the U.S. Energy Information Agency predicts that unconventional gas will represent 56% of U.S. natural gas supply by 2030 from 27% in 2000, led by increases in shale gas production. In Canada, production of unconventional natural gas resources is expected to rise dramatically and shale gas alone could reach 1.7 billion cubic feet per day by 2020.Ultimately, the success of unconventional development in North American natural gas supply is contingent on the interplay of technology, cost, environment, and natural gas prices.will slow development because shale gas development is highly dependent on technology, Securing investments will become more intense results: unconventional gas to draw away new investments that may otherwise go into conventional gas play, Gas prices remain lower due to global gas supply glut results: production from unconventional sources and conventional LNG may worsen and prolong supply glut prices expected to remain soften. waning interest for imported gas from major markets: declining interest for imported gas especially from major consuming countries, technology breakthrough, technical skills and supportive economics remain key drivers for future growth consist: pushing the industry far along the learning curve making the development a lucrative proposition other infrastructure: the pace of unconventional gas development can be slow if operated within a poor infrastructure environment. Harnessing opportunities: abundant gas resources:vast unconventional resource of more than 32,000 Tcf ,may alter global gas balance outlook ,reserves are more than double of conventional gas, open access: resource nationalism limits access only to conventional gas reserves, relatively low entry level providing opportunity for land grabbing and new ventures.

Conclusion

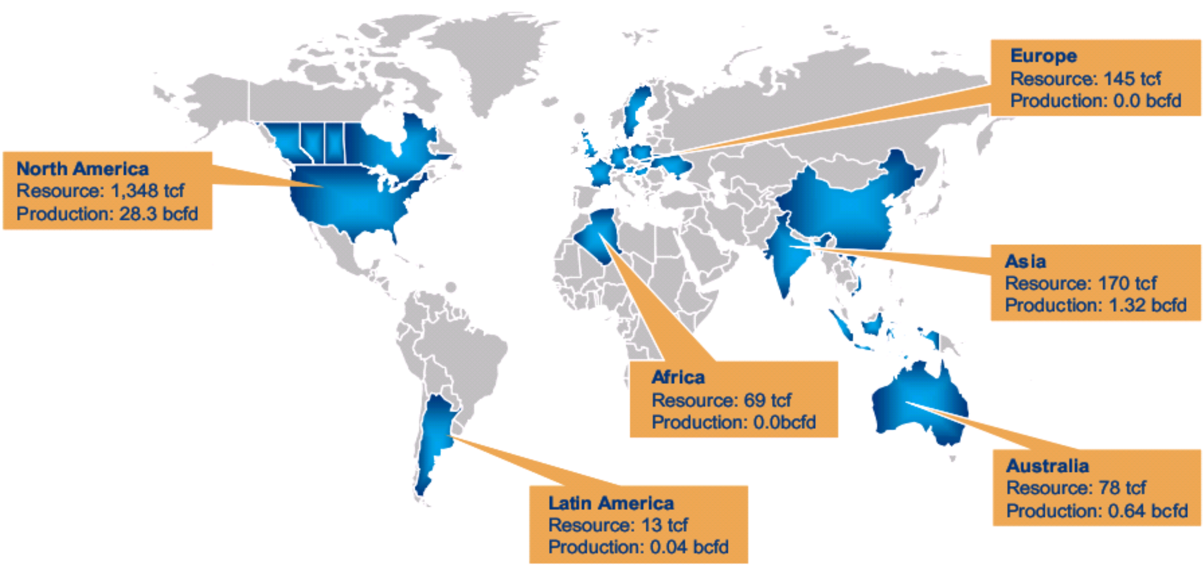
Production from unconventional gas reservoirs such as shale gas, has been prevalent in North America for several decades and is becoming increasingly important in Australia and the Asia Pacific region. The price of gas is linked to oil and based on each fuel's heating value. the ratio is about 6 to 1.In other words, 1 bbl of oil contains about 6 times more heat energy than 1,000 ft of gas. If a barrel of oil sells for USD 100.00, then 1,000 ft of gas is worth about USD 16.00. As long as oil prices remain high, there is no reason for natural gas prices to go down. Although gas is abundant in much of the world, it is expensive and potentially dangerous to transport internationally. The future of shale gas until recently, there was very little specialized oilfield technology to help produce gas shale reservoirs. but with the growing demand for natural gas in the United States, and the fact that many US gas fields are in decline, we believes that every new source of natural gas should be exploited .while no single source will completely fill the gap, we believe that shale gas is part of the solution, not all. Finally, as a overview on the world's supply vs. demand in the short & long term outlook: Middle East, Russia & CIS and Africa emerge as key gas exporters, Europe remains the largest net gas importer, Asia Pacific and Latin America are net gas importers, North America has transformed itself to become a self sufficient gas market.Gas prices of $4/mmbtu (~€10/MWh) indicate that development, drilling and production is competitive, some results this paper estimates that: break even costs below $3/mmbtu (~€7/MWh) for various shale plays possible and even conservative estimate (Wood Mackenzie) for breakeven cost lower than current gas forward prices of $7/mmbtu (~€17/MWh).

Figure1: unconventional gas is now the dominant source of U.S



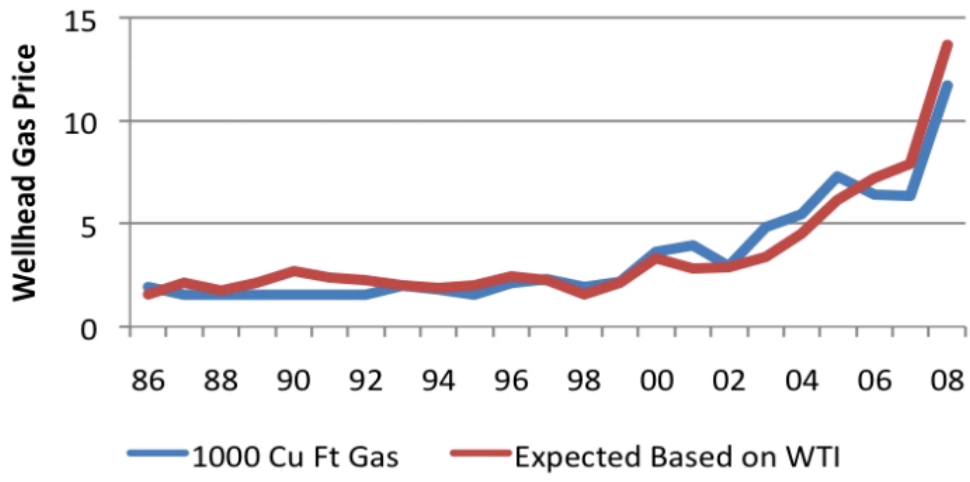
Data Source: U.S. Energy Information Agency (2010); Advanced Resources Int'l (2010)

Figure2: North America has the largest known potential, but advances in Europe and Asia pacific are growing global resource estimates elsewhere



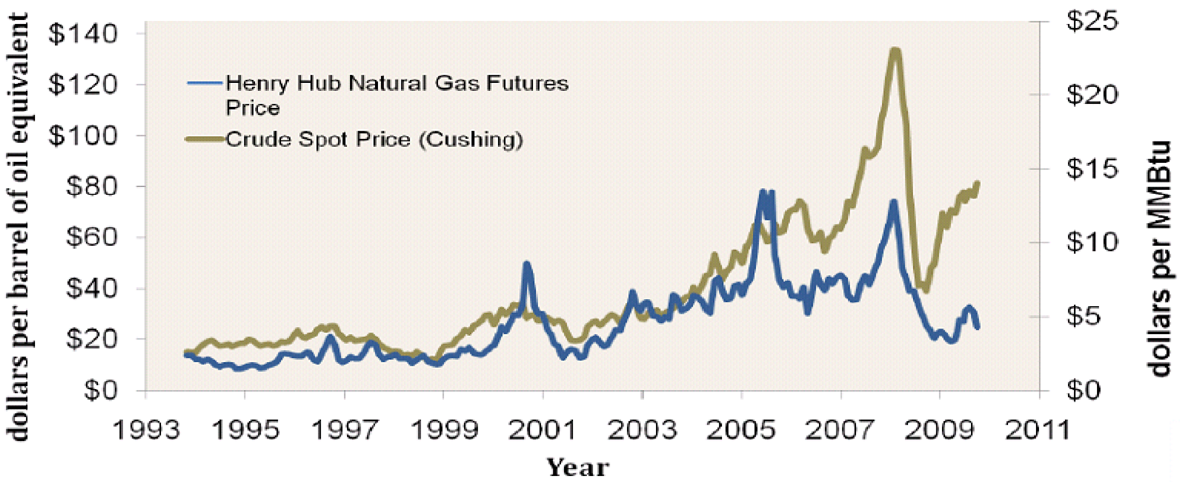
Data Source: wood Mackenzie, BG Group

Figure3: Gas Price Compared to WTI Expected



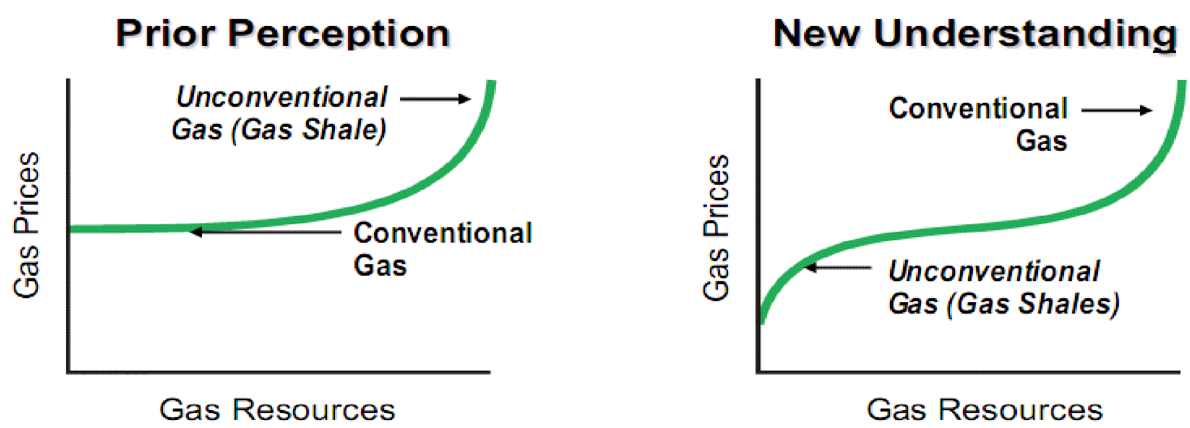
Refrences :[2],[8]

Figure4:U.S. Oil and Natural Gas prices 1994-2009



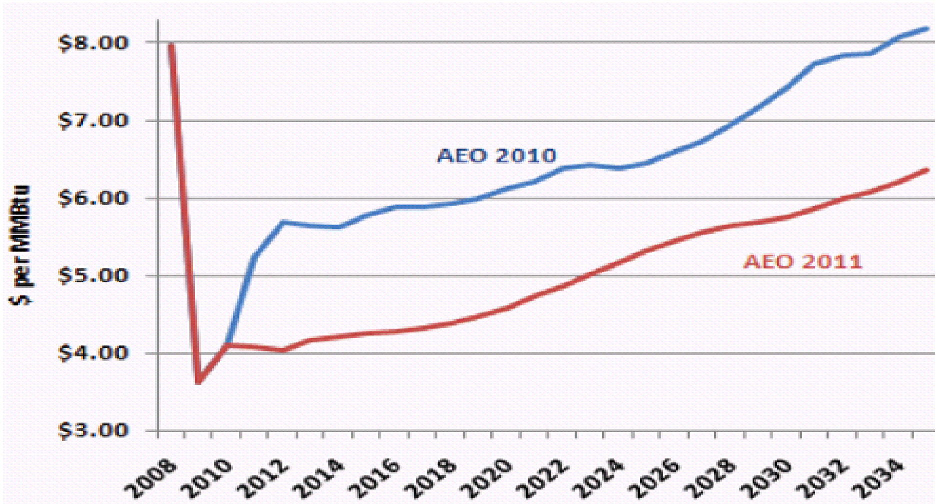
Refrences :[2],[8]

Figure5: Natural Gas Price/Resource curve



Data Source: [3],[4],[8]

Figure6: Natural Gas Prices AEO 2010 versus AEO 2011(early release overview)



Data Source: Annual Energy Outlook 2011, [5]

Figure7 : Comparing the wellhead price of gas with Henry Hub spot price

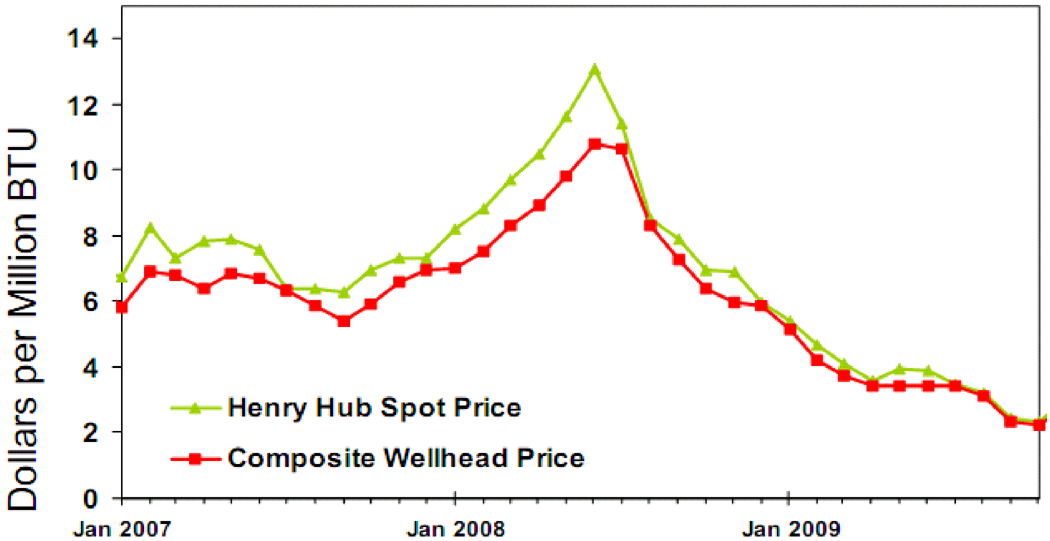
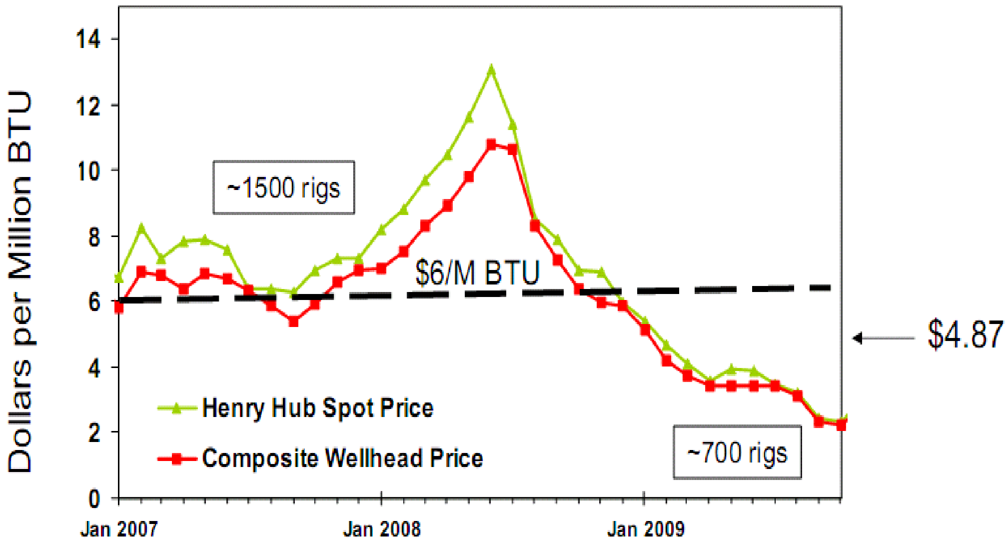


Figure8: Inexpensive (and stable) gas prices



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