

# GAS AND OIL SHALE

*The growth in unconventional hydrocarbons has passed from adolescence and is approaching an age of maturity. Yet, optimism must be offset the concerns for those living closest to the revolution. Glancing back over the North American and Australian experiences some preliminary conclusions can be drawn. While best practices are making a contribution to sustainable production the equation will remain incomplete without fearless public debate of the subject.*

Reviewing the heady days of the IT revolution of the 1980s and 1990s, when ever smaller microprocessors and the miniaturization of printed circuit boards led to exponential growth in the power of silicon chips, we can make out a near mirror image of what we are now witnessing in the oil and gas industry, and more specifically the unconventional sector of the market. Both “revolutions” were characterized by greater efficiency, which led to stable prices and increased power.

The fortuitous intersection of advances in directional drilling techniques and the use of hydraulic fracturing have completely shifted the parameters of exploration and production (E&P) and altered them to their core. Today it is possible to extract from a single modern well what once would have required dozens and at a cost only fractionally higher than just *one* of these traditional wells.

## **The Shale Gas Revolution**

Receding only a few years back into recent North American history the picture was radically different. Indeed, at the dawn of the new millennium massive capital investment was made in terminal infrastructure for the importation of liquefied natural gas (LNG) in advance of a widely anticipated penury in domestic resources. In the intervening decade this logic has been turned completely on its head due largely to the widespread adoption of horizontal drilling and hydraulic fracturing to exploit the country’s vast shale gas resources on an industrial scale, a path the multi-nationals had until recently seen as either too expensive or simply not practical.

By 2008, the market had been flooded to the point that storage capacity was saturated and prices went into free-fall. The import market essentially collapsed as new technology opened the floodgates on vast untapped resources, enough to satisfy domestic consumption well into the next century.

Drawing inspiration from the natural gas market it didn't take long for a handful of pioneers to start deploying similar technology and know-how to the exploitation of abundant oil shales. The gap between gas and oil prices makes the latter rather more attractive which was all the incentive that was needed. The industry, still in its infancy, has yet to prove whether the initial hype surrounding these liquid-rich plays is justified but the stirrings of another revolution are already afoot and two remarkable success stories demonstrate this point.

At first glance observers will note that whereas in 2008 close to 80% of onshore drilling equipment in the US was deployed for gas exploration and a mere 20% for oil the current ratio has become equally split at 50%-50%. Investment in mineral rights to well established shale plays (*Eagle Ford* and *Barnett* in Texas, *Bakken* in North Dakota) has skyrocketed and stock prices have been shooting up by a factor of as much as ten over the last two years. Despite the moratorium on offshore drilling in the Gulf of Mexico in the wake of the *Macondo* field oil spill, U.S. production actually rose in 2010 stemming years of decline and casting doubt on Hubbert's well-worn theory positing irreversible decline in U.S. production from its peak in the early 1970s.

The *Bakken* shale formation was producing no more than 10,000 barrels per day in 2003, a mere trickle compared to current production which has surpassed 400,000 barrels per day. Is this the result of some geological miracle? No, the keys to the transformation are the aforementioned advances in horizontal drilling and fracturing techniques. Meanwhile in southern Texas the *Eagle Ford* play, from even humbler beginnings, has been gushing forth 125,000 barrels of crude per day since 2009 to which can be added a roughly equivalent amount of natural gas. Speculators are now eyeing up other potentially liquid-rich plays such as *Niobrara* in Colorado, Ohio's *Utica*, *La Vaca Muerta* in Argentina, and *Lias* in France's Parisian basin. Specialized analysts of the sector are already tipping the United States to figure among the countries where the production of black gold is predicted to increase the most between 2010-2020 along with Canada, Brazil, Iraq, and Kazakhstan. Some are even predicting the bottom to fall out of the market for oil which would come as somewhat of a shock to the majority of the public who have long been resigned to an ineluctable rise in oil prices.

### **Public Introspection and Economic Stakes**

The attitude of local environmental groups toward rapid development in unconventional hydrocarbons in North America remains ambivalent and local activists have been highly vocal in their campaigns to denounce the danger of hydraulic fracturing and its potential

to contaminate groundwater supplies. A patchwork approach to regulation has evolved leaving individual states to formulate policy and practices permitted in one may face stiff safety standards in another. Some states, such as North Carolina, have outlawed the practices altogether. The concerns are not without foundation and in Pennsylvania regulators suspended one drilling firm's operations in Dimock on the basis of evidence of contaminated drinking water in 14 households as a likely result of chemical leakage near wells. Production was effectively halted pending the sealing of a number wells and fines were imposed. Environmental activists have also released studies which indicate that the levels of natural gas surrounding wells exceed anything that could be considered normal while others attribute these anomalies to naturally occurring phenomena.

What should not be lost in the discussion is that hydraulic fracturing has been used for decades and is a mature technology that has been deployed over a million times since 1947 when it originated in the United States (often to "push" wells reaching the end of their active life). Over this entire period not a single major ecological catastrophe has been attributed directly to the practice. Nevertheless, the Environmental Protection Agency (EPA) was directed to launch a far reaching investigation into the practice in 2010 and the widely anticipated interim results will be released in 2012.

It should come as no surprise that in Europe, a continent traditionally more sensitive to environmental concerns, the deployment of the new technology remains a hotly debated topic. In Britain, the press seized on the danger of seismic disturbances after two small earthquakes in Blackpool—one measuring 2.3 in April and another registering 1.5 on 27 May—to fan the flames of public wariness toward hydraulic fracturing. An inquiry concluded that the tremors were likely the direct result of water and chemicals being pumped at high pressure in order to shatter rock formations and release gas nearby. Across the Channel, concerns over underground aquifers pushed the French parliament to vote overwhelmingly in favor of a suspension of drilling activities in June 2011 while nevertheless leaving the door slightly ajar to future development as certain types of exploratory work were left untouched by the legislation.

The political and economic stakes of the rise of unconventional approaches to hydrocarbon extraction have captured the attention of policymakers many of whom have become increasingly sensitive to the subject. In an era of austerity measures and high unemployment states such as North Dakota, site of the *Bakken* play, are bucking national trends and demonstrating rude economic health. Unemployment is the lowest in the United States: 3.5% compared to a national average of 9.1%. Increases in domestic

production mean less dependence on foreign crude and serve to reduce negative energy-related stress on the U.S. trade deficit. National demand is decreasing while supply is on the up and oil imports now account for a mere 47% of the U.S. energy market compared to 60% in 2006 which is roughly equivalent to 4 million barrels per day. Lest we forget, Norway was an economic backwater only a few decades ago and has risen on the strength of natural resources from being the poorest country in Europe to one of the richest in the world. What better illustration of why black gold truly merits its unofficial moniker? Geopolitically, Russia has repeatedly demonstrated a willingness to use natural gas as a political weapon to gain concessions from its commercial partners, who depend on its pipelines to furnish their own domestic energy needs, often threatening to switch off the tap on which millions of customers depend and in some cases actually doing so.

### **Industrial Safety and Competitors of Many Colors**

The actual fluid that is pumped into a well during fracturing is composed almost entirely of water and sand. Chemical additives (used to facilitate the process) make up only 0.5% of the total but they are the most controversial and present the greatest danger to the environment. The sedimentary layers of rock in which hydrocarbons are found are commonly several thousand meters below underground aquifers. Specialists and the current state of the art consider fractures in the deepest wells do not exceed a 100 meter vertical radius from the tubes that make up the well casing. Contrary to popular opinion the real risk of groundwater contamination arises not so much from the process of fracturing but from damage and fissures in the upper reaches of the well where poorly cemented well casings can be exposed to considerable force through the mechanical constraints of high pressure fluid injection or rapid cooling leading to damage through thermal shock. Yes, there is always a danger that poorly constructed wells could lead to contamination of aquifers and the surrounding environment but experienced firms, and especially those with a long history of offshore drilling, have refined engineering techniques and safety standards to the point where risks have become negligible or indeed eliminated altogether.

It is difficult to pigeonhole the entire industry because the players form an extremely diverse bunch ranging from well-known multi-nationals to a vast array of bit players who operate on a much more modest scale. Company culture reflects this diversity and approaches toward safety and risk can vary considerably from one end of the spectrum to the other. Start-ups line up alongside well established firms and are not always able to draw on the same levels of technical expertise. Certain majors have implemented rigorous internal standards by integrating models used in countries such as Brazil and

Norway, both known to have some of the most refined, and constraining, regulatory regimes in the world. Others take a more cavalier approach and are willing to cut corners to reduce operating expenses. Some companies are simply too lightweight to possess the reserves of know-how necessary to ensure the levels of professionalism associated with their larger contemporaries.

In France, the debate over the future of the sector has been somewhat spoiled of late by the arrival of speculators who, as a result of time constraints or lack of sufficient capital, seem more concerned with quick profits than long-term investment. Unfamiliar with the history of oil and gas exploration these venture capitalists are scrambling to acquire high quality acreage and while technological advances often depend on risk-taking pioneers these individuals can also prove a double-edged sword. The cause of long-term growth in unconventional hydrocarbons is not being helped by intensive lobbying efforts to push through legislation which seems designed more to boost stock prices by forcing the hands of regulators than create sustainable development. This approach stands in stark contrast to a long-term investment strategy which covers multiple decades across a particular region and takes into account the social and environmental consequences for the surrounding community from beginning to end. Companies attempting to fudge these issues through oversimplified arguments, or outright lies about the possible dangers of industrial-scale fossil fuel extraction only serve to cloud the debate and are ultimately counter-productive. Indeed, without transparency, these firms are actually creating conditions that will likely lead to their own demise as the truth is revealed and promises inevitably broken.

### **American Exceptionalism**

If the United States has become the epicenter of the boom in unconventional hydrocarbons no small part of the country's success can be attributed to the convergence of a rather unique set of mining regulations that may prove difficult to replicate elsewhere and remain largely unknown to the wider public. Most importantly, in sharp contrast to other parts of the world, mineral rights remain firmly in the hands of landowners. Private entities can lease land and receive royalties on any drilling operations. In the eyes of those living nearest to the drilling sites the vista looks rather different when they know that these eyesores translate into more cash in their pocket. Across the Atlantic landowners have a less rosy view as the disruption caused by surface operations serves to shore up central government coffers rather than their own. In France, the government reaps the rewards, to spend as it sees fit, and the local residents suffer the consequences while their American counterparts have a direct financial stake that can often be substantial.

Beyond legitimate environmental concerns, my belief is that the principle underlying obstacle to further development of shale-based resources hinges on this simple difference between the French and American mining codes. Why would anyone suffer all the associated disruption caused by the surface activity of any industrial-scale operation when they receive no identifiable benefit? The way forward is to reconcile the needs of the various stakeholders by conducting a thorough review of current mining regulations, indeed altering them if necessary, in order to encourage a meeting of minds for the interests of the wider public. Without this level of dialogue it is hard to imagine shale-based production ever reaching an industrial scale of the kind we are witnessing overseas. Transparency and the public good must be placed at the forefront of discussions which was certainly not what transpired during the unedifying spectacle of the current government quietly dealing out shale gas exploration permits behind closed doors in the spring of 2010.

The institution of a complementary regime to ensure the equitable distribution of risk provides another essential component for future development. Drivers are required by law insure their vehicles against road accidents. It would not be unreasonable to mandate that a portion of drilling royalties, as well as fixed financial guarantees, be set aside in a general fund to insure against the possibility for environmental damage through pollution or other degradations that may have an effect on local populations. Even the most well-intentioned firms find it difficult to wade through the complicated procedures required to establish the payment of indemnities for the collateral damage of drilling operations. To take a simple example, if road networks are damaged by the increased traffic that will inevitably result from the sheer number of tanker trucks needed to service a single well (due to the extraordinary amount of water demanded by hydraulic fracturing) the drilling company is not necessarily responsible because it never owned the roads in the first place.

### **Anticipation Through Consultation**

Australian economic growth is deeply intertwined with a strong energy and mining sector and the path they have followed to become an essential link in the Asia-Pacific region's seemingly insatiable demand for raw materials is one that deserves closer examination. The country now finds itself engaged in a process of enlarging export infrastructure to create improved links with commercial partners such as China, India, and Japan with combined capital investment from a diverse range of interests that is expected to mount into the tens of billions of dollars over the coming years.

As the country ramps up to become a world leader in LNG exports the fortunes of small towns such as Gladstone in Queensland are preparing to undergo a considerable transformation. With the construction of three new processing facilities the population is expected to rise from approximately 50,000 today to 80,000 by the time the project is completed in the next three to four years. Trucks carrying all kinds of materials over the region's road network are expected to amount to around 100,000. With admirable foresight into the potential for the disruptions that such massive construction is likely to provoke, the relevant authorities launched preliminary studies in the following domains: environment, infrastructure, and the ramifications for the labor market. Permission to proceed with development has been granted on the strict condition that unions adhere to pre-arranged protocols and agreement were created between the government and its new industrial partners to resolve any degradation of the local environment and the possibility for shortfalls in suitable housing stock that will arise with the massive influx of new community members.

Open dialogue and a clear blueprint for the future changes the development equation and allows for more productive collaboration through the ups and downs over the life-cycle of major infrastructure construction where challenges for local residents and the environment are an inevitable by-product. To avoid the need for protracted conflict resolution or passage by force a spirit of partnership is essential and proves the old adage that sometimes it is good to talk.

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