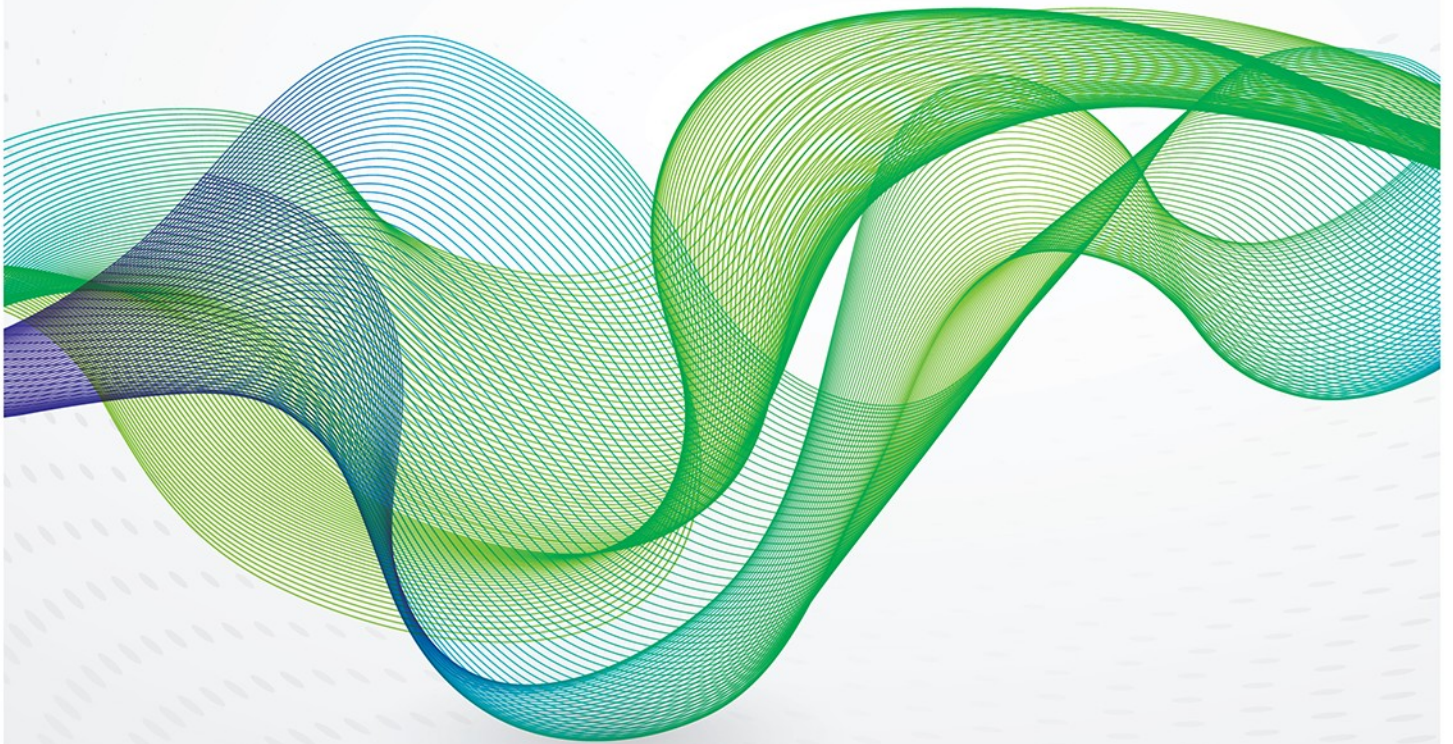


March 2014

US shale gas and tight oil industry performance:

challenges and opportunities





In just seven years, the United States (US) shale gas and tight oil revolution has created significant new challenges and opportunities and a new known-unknown that energy market players and analysts must learn to deal with in the years to come. Since 2006, US oil and gas production has responded vigorously to high prices and technological innovation and total production is now at a record high (and rising), driven by new business activity in several giant 'new' plays (i.e., Barnett, Fayetteville, Haynesville, Marcellus - gas plays - , Bakken, Permian and Eagle Ford - oil plays -). The US is now the world's largest producer of natural gas and currently produces 8 million b/d of crude oil, up from 5 million b/d in 2008.¹ The potential recoverable reserves of these new plays in the US and globally could be so large² that they may exceed the cumulative production of world oil and gas for the last 100 years.

This revolution may be characterized by recent material supply increases in the US, but most importantly by the promise to bring to market substantial, difficult-to-produce, high-cost reserves for decades to come. Taking a broad consensus, the emergence of this new business and unprecedented supply response is the result of at least four factors: (1) global price increases, (2) drilling of a large number of wells, along with technological advancements in horizontal drilling and hydraulic fracturing, (3) capital and credit availability in the US, in addition to international funding, and (4) changes in the international business environment, such as the rise in political risk in many countries, as well as limited licensing rounds in other prospective areas outside the US. Other factors, such as water availability, type of land ownership, rigs, hydraulic fracturing horsepower availability and regulations, could be considered both drivers and enablers of the revolution.

Annual capex associated with shale and tight oil plays has increased exponentially, from around \$5billion (b) in 2006 to more than \$80b in 2013³. Further, more than \$200b of mergers & acquisitions (M&A) deals⁴ and joint ventures (JVs) have been completed as part of industry positioning (i.e., millions of acres with potential resources have been traded). Some call this supply surge epic — a once in a lifetime opportunity that is still unfolding. However, outside the US, there has been little visible supply response except in Canada (mainly gas) and to some extent in Argentina (mainly oil), while China has embarked on an aggressive shale development effort, so far with mixed results. Time and politics will tell if these plays and production techniques can be replicated elsewhere. The speed at which capital and innovation have moved in the US has not yet been replicated in any other country that may be rich in similar resources.

Today, one can find all kinds of reports and information with detailed play maps, potential resources, economics per well, initial production (IP) rates and long-term supply outlooks. There are also well-versed stories available about the prospects of US energy independence, new policy calculations and future military strategies, how Russia's influence and its gas industry are likely to weaken, and even the re-contextualization of climate negotiations, to name a few. In a recent *FT* article⁵, Ed Morse went as far as suggesting that the revolution unfolding in the US is now spreading globally and that it will erode OPEC and the old oil regime. Morse also suggested it represents a turning point for a more secure US and global energy system; an opportunity that should not be missed.

¹ EIA Short Term Oil Outlook Report, EIA databases

² Advanced Resources International; estimates around about 1.5 trillion boe of technically recoverable

³ Oswald Clint, Director Bernstein, The Dark Side of the Golden Age of Shale and Tight Oil, May 2013

⁴ Derrick Petroleum databases

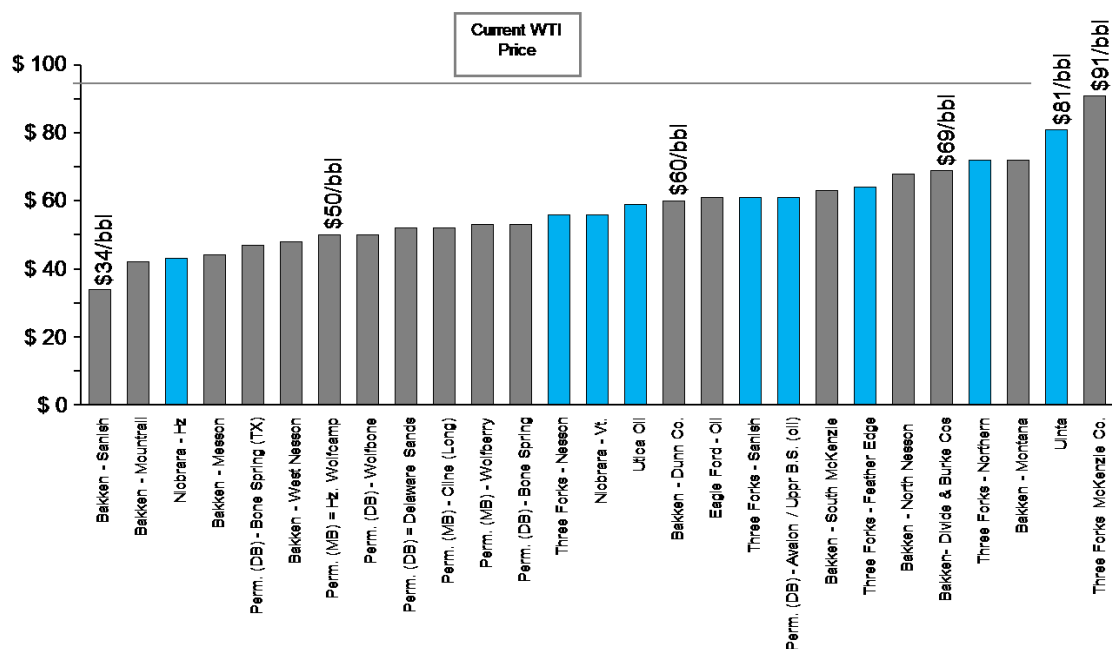
⁵ Ed Morse, *managing director and global head of commodities research at Citi*, US energy revolution will end old Opec regime Op Ed, *FT*, 14 October 2013

The Viability of the Business Model

Despite the obvious current capital markets and investor consensus that shale gas and tight oil (maybe to a lesser extent shale gas currently) is a must-have in the portfolio — share prices and valuations for most US exploration and production companies (E&Ps) have been trading at record highs.⁶ The less talked about but highly critical questions are related to the economic model, the viability promised to investors that companies will extract large volumes of resources, and the sustainability of these new plays that have been de-risked and are in the development/growth stage.

In order to keep these plays going, build a scalable industry and ultimately meet expectations for future long-term US supply increases, exploitation must be viable commercially for industrial investors to stay in the business and rational investors to keep funding the activity beyond the initial excitement. Currently, the conventional wisdom is that on average, most shale gas wells are out of the money while tight oil wells are in the money, and on the whole, it is considered an attractive business in which most commercial challenges will be ultimately overcome.

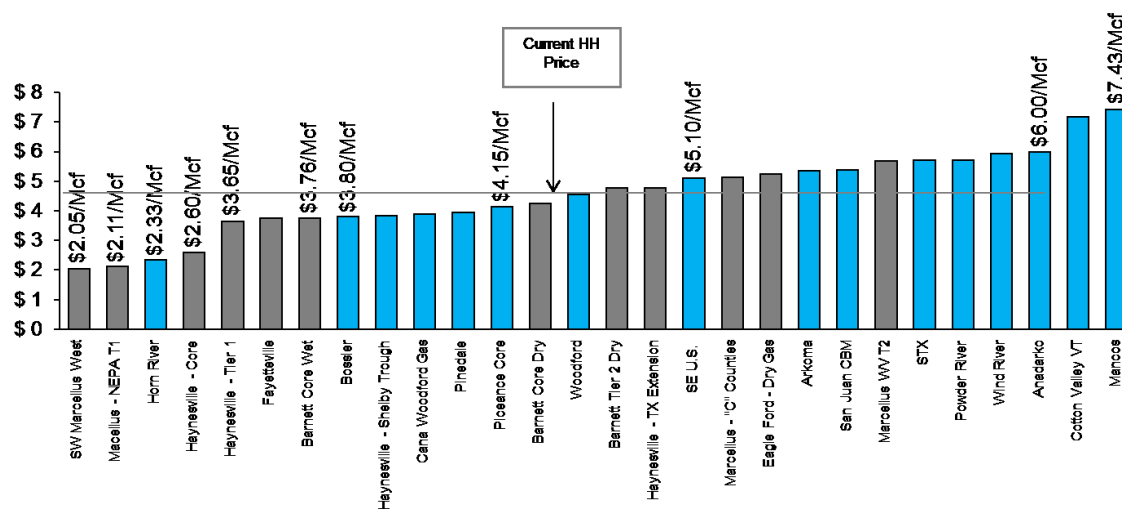
Figure 1a: Basin economics for various US plays (single well) tight oil



Source: TPH and HPDI (Global Shale Conference, 21 November 2013); BE required for 10% IRR, including capital recovery. The authors indicate that the chart excludes large number of conventional and non-conventional, which generally have less attractive economics. Grey color shows major producing plays.

⁶ Valuation reports of various equity research reports, *FT market databases* and *Oil and Gas Journal*

Figure 1b: Basin economics for various US plays (single well) shale gas



Source: TPH and HPDI (Global Shale Conference, 21 November 2013); BE required for 10% IRR, including capital recovery. The authors indicate that the chart excludes large number of conventional and non-conventional, which generally have less attractive economics. Grey color shows major producing plays.

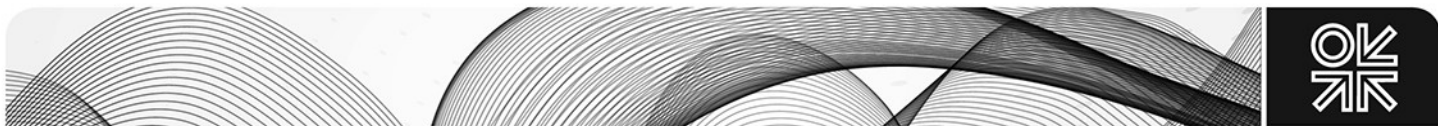
The evidence so far suggests that the industry has been able to create new opportunities, manage and innovate around the operational aspects (i.e., drill more wells per pad, longer laterals, faster drilling, more hydraulic fracturing/wells, micro seismic, synchronized logistics, etc.) and deal with or address the environmental challenges, despite a rough start and evolving government policies and public acceptance issues. What is not clear from higher-level company data is: if the industry (both large players and independents) can run a cash flow -positive business in both top-quality and in more marginal plays and whether the positive cash flow could be maintained when the industry scales up its operations.

Among all the data and evidence at hand, this comment focuses around the following pieces of industry data that capture a vast amount of relevant context (technical and commercial) and decision-making: (1) recent announcements by large and small industry players, such as write-downs, and (2) financial performance analysis of select US shale gas and tight oil independents.

Write Downs

Since the shale boom began, related write-downs by several of the largest shale players are now approaching \$35b⁷, suggesting that some of these plays will not meet original technical and business expectations. Most of the large write-downs have been made by foreign players but also by some US players too. If one adds all unconventional-related write-downs, from both US and non-US companies, made during the last 10 years, the figure of write-downs increases significantly.

⁷ Public announcements by Chesapeake, BHP, Encanda, Quicksilver, BP, Devon, Total, Shell, Eni, Ultra, SWN, Oxy, Newfield, Anadarko, PXP.



There are many considerations for taking a write-down. These include for example, purchase price, investment, current and future economic conditions. But none are likely to be for good reasons, nor are these welcomed by investors. However, more such write-downs are expected. An obvious question is why take a write-down now and does it change things going forward?

In a recent *FT* interview⁸, the CEO of one of the largest foreign investors in shale noted his disappointment with the company's US shale-related investments (about \$24b since 2008), having already made a large write-down. The company also said that it is reviewing future investments and selling its stake across various shale plays. While most of the companies that have made write-downs are not quitting, many players in this industry have already noted that the revolution is not as technically and financially attractive as they expected. However, to deem the model flawed due to the investment write-downs of some large companies would be misleading and too early in the evolution of the business for some players.

It is true that the majors and international companies had less capability to fully appreciate what type of business they were getting into and what assets and acreage positions would work. The same might be said for several medium-sized and smaller players that have reset their strategies to this new business and have limited capital to fully evaluate and exploit their assets. In a recent industry event⁹, the former CEO of another major shale player, who sold the company for several billion dollars to a foreign player in 2011, noted that the only day his company was cash flow positive was the day it was sold!

Many companies have also said that it will take decades before a similar business can develop outside North America — a message that appears to have been ignored, especially by governments in countries such as Poland and Argentina. Several of the largest international majors have openly highlighted the challenges faced outside of North America. For instance, about 80 per cent of global hydraulic fracturing horse power (HP) (19 million HP) is in the US,¹⁰ and this constitutes one of the key limitations to developing the business beyond North America. Additionally, local conditions outside the US and Canada are drastically different, regardless of how many similarities one tries to find. How these aspects will affect developments over time is not yet known, but few are putting large-scale money on the table.

Financial Performance

With regard to the financial performance of companies in this sector, a recent analysis covering 35 independent shale gas- and tight oil-focused companies active across the major US plays and accounting for 3 million barrels of oil equivalent (mboe) per day of production (40% of the total unconventional production in the US at 3Q2013), shows that over the past six years their financial performance has progressively worsened.¹¹ This is despite showing production growth and shifting a large portion of their activity to oil since 2010, presumably to chase a higher margin business.

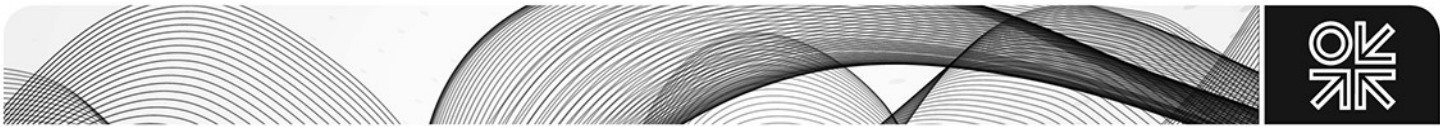
The analysis shows that capex nearly matches total revenues every year, and net cash flow is becoming negative while debt keeps rising. There are other factors, such as the close link between

⁸ Guy Chazan, *FT* Reporter, Interview with Peter Vossler, October 6th, 2013

⁹ TPH Global Shale Conference, 21 November 2013

¹⁰ TPH Global Shale Conference, 21 November 2013

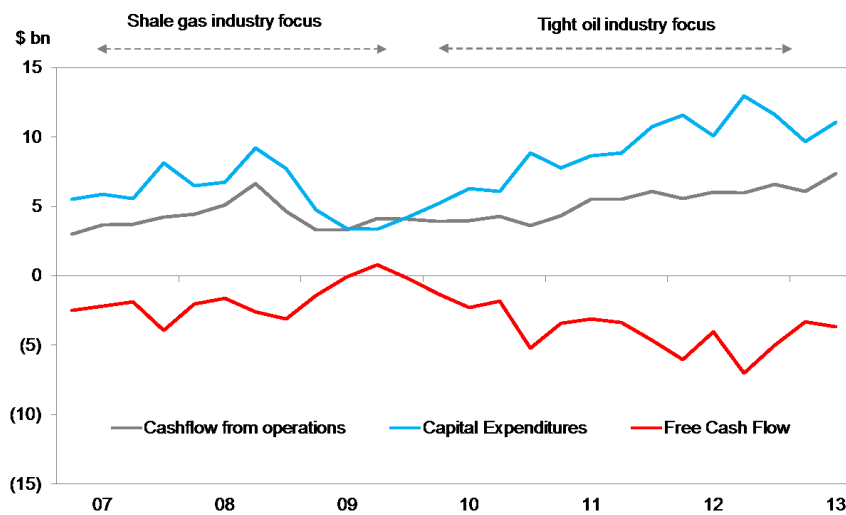
¹¹ Energy Aspects, Amrita Sen, Director, In focus – the other tale of shale, October, 2013



rising debt and production, the rising cost of debt to total revenues and negative cash flow, which add to concerns about the sustainability of the business. Company data also shows that the cash flow per share of US independents, many of which are investing in shale and tight oil prospects, is negative and has been trending more negative with time.

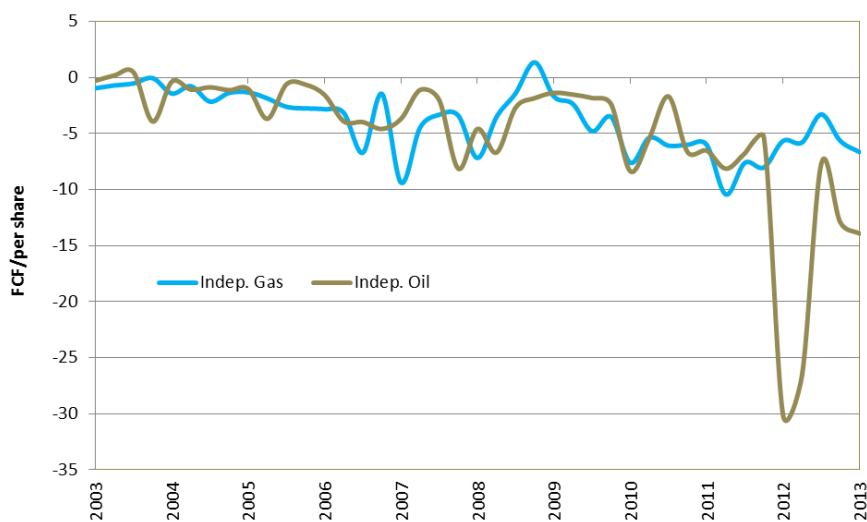
However, although the market (and some industrial investors) may be wrong, or unable to distinguish profitable from unprofitable opportunities, there remain a large number of investors who have made substantial investment as well as many that believe that these companies will eventually make money, especially from M&A activity.

Figure 2: Financial survey of 35 US shale gas/tight oil companies



Source: Energy Aspects; In focus – the other tale of shale, Oct 2013; Other analysis EY

Figure 3: Cash flow per share of US oil and gas independents



Source: Bloomberg; Independent Analysis



From an industrial point of view, these trends are not necessarily problematic, assuming that there will be a positive inflection point for cash flow and a full cycle risk-adjusted return. Some major players see this economic inflection coming in another five years from now, since it is a fledgling industry. Given depressed natural gas prices, the North American shale gas side of the boom will likely take much longer to be fully understood and financially evaluated. With stable oil prices (and a reduction in regional North American discounts), large and strategically placed US independents should either begin to reduce their debt levels and continue stable development over the coming years or illustrate that the model is in fact flawed and the oil is too expensive to get out of the ground. Not all of these companies are going to end up on top, but shifts in commodity prices and performance improvements will result in a stable “core” group holding the prize.

The inflection point in this boom is unlikely to be the same across the industry or even across the plays, and it will depend upon a number of factors: including which plays a company is in, when they entered each play and what stage of development they are in, how they are spending their debt in each play, and exactly what and for how long they need to keep spending in order to fully evaluate their assets. The funding machine is undergoing rapid changes. Sources of funding are now led by private equity, high yield debt, capital release from the sale of midstream assets into master limited partnerships (MLPs) and the sale of more non-core assets. There are fewer JVs with foreign capital providers, certainly from outside China, and less reserve based lending (RBL), hedging, and equity issuances.¹² It is estimated that for a large group of companies involved in this unconventional oil and gas development 60 per cent of their total cash needs (cash, capex and acquisitions funding) is continuously coming from non-operational cash flow, rather from ex portfolio, equity, and debt management activities.

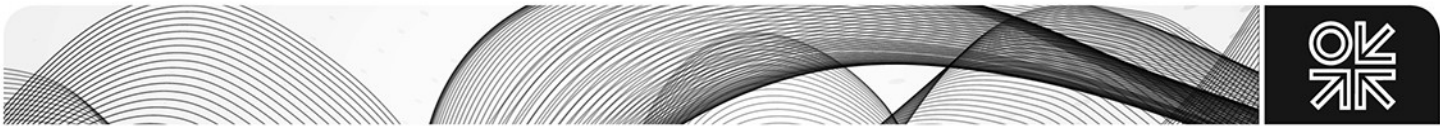
For the global oil and gas industry, leading industry research¹³ shows that performance has been deteriorating and is likely to remain weak for a few more years before it can improve again. A key finding of a broader US E&P benchmark study carried out by Ernst & Young in 2013 was that both exploration and development costs are increasing rapidly – by more than 20 per cent in 2012 alone. The oil and gas industry has experienced falling net income margins over the past few years, and shale gas has played a significant part in this trend. It is a complex system, and not the subject of this paper, but it is important to note that, returns and cash flow are all under pressure even at these current high prices and a significant capex and cost reduction is needed. Additionally, production and revenue increases are needed to rebalance the industry’s financial and strategic model. The impact of shale gas and tight oil business activity on these trends is a subject of much debate.

Challenges Ahead

In the near and medium term, it is increasingly evident that the new US shale gas and tight oil industry is likely to remain challenged, which is partially why the write-offs have been made. The above-ground list of reasons include the need to constantly acquire and drill leases, more often than not based on geography rather than geology, infrastructure needs, transportation costs, increasing costs to manage environmental considerations as operations grow, and importantly, the fact that drilling and hydraulic fracturing costs respond to fluctuations in gas and oil prices as well as demand, leaving little excess profit for long.

¹² TPH Global Shale Conference, 21 November 2013

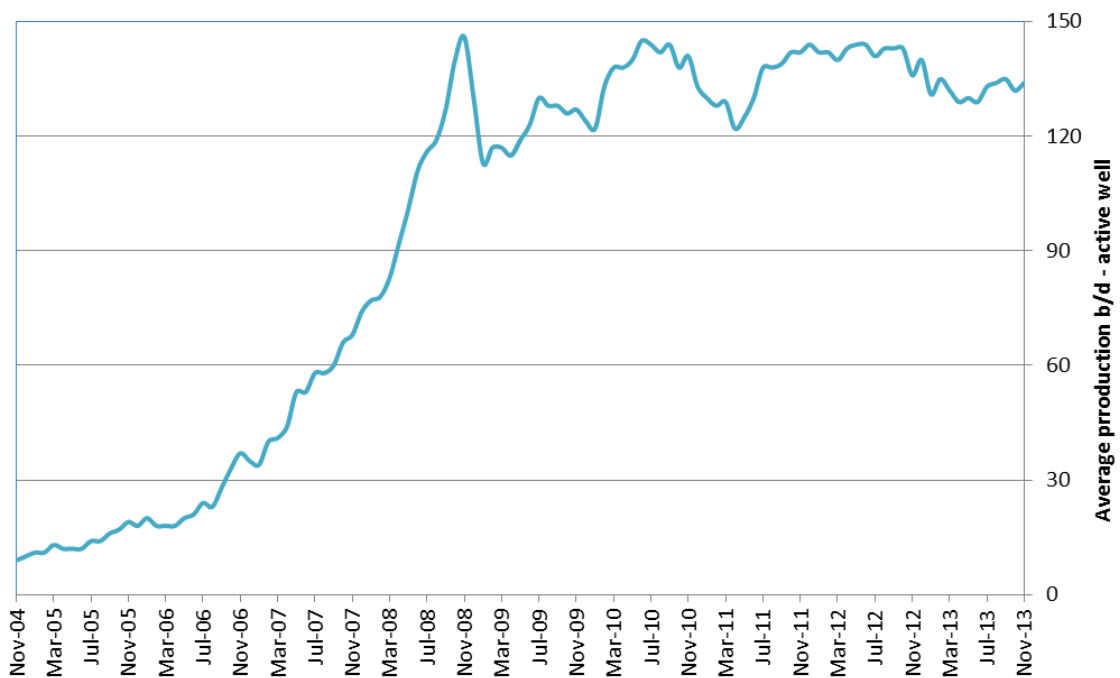
¹³ Oswald Clint, Director, Bernstein Energy: The Dark Side of the Golden Age of Shale and Tight Oil (May 2013)



Below-ground, technology and innovation are helping to get the molecules out faster, but on average the decline curve profile, and recovery factors may remain broadly unchanged for many plays and could possibly weaken as the industry moves to target the more difficult acreage positions. While gas plays have not seen substantial improvements in IPs due to various reasons including the lack of development for dry gas, IPs in the Permian Basin as well as the Bakken and Eagle Ford have been steadily increasing year on year, but the steep decline profile ultimately remains the same across these plays. Recent leading technical research¹⁴ has shown that in some ways, tight oil and shale gas plays are similar - they are both extensive, exhibit high first-year well decline rates varying from 65 per cent to 90 per cent, and have low recovery efficiencies averaged over the entire play: 7 per cent for shale gas and 1-2 per cent for tight oil. Tight oil reservoirs have higher permeabilities and porosities than their shale gas counterparts, in the range of 40 microdarcys with porosities around 5 per cent, respectively. 'Sweet-spots' in oil recoveries can reach 5-6 per cent.

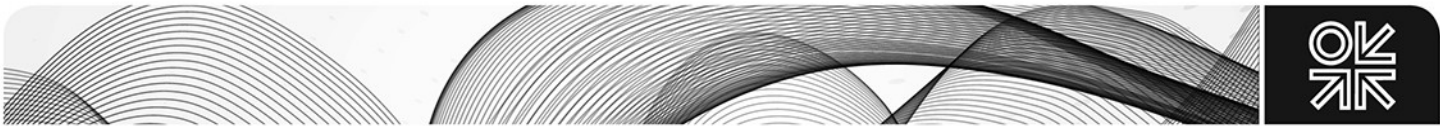
Substantial effort, with good progress, has been made in recent years to increase the average production per well. However one can see, for instance in North Dakota's Bakken, that the average production rate per well is not increasing as before and the amount of new wells it takes to obtain a similar increase in overall production is rising.

Figure 4: Bakken: average production per well



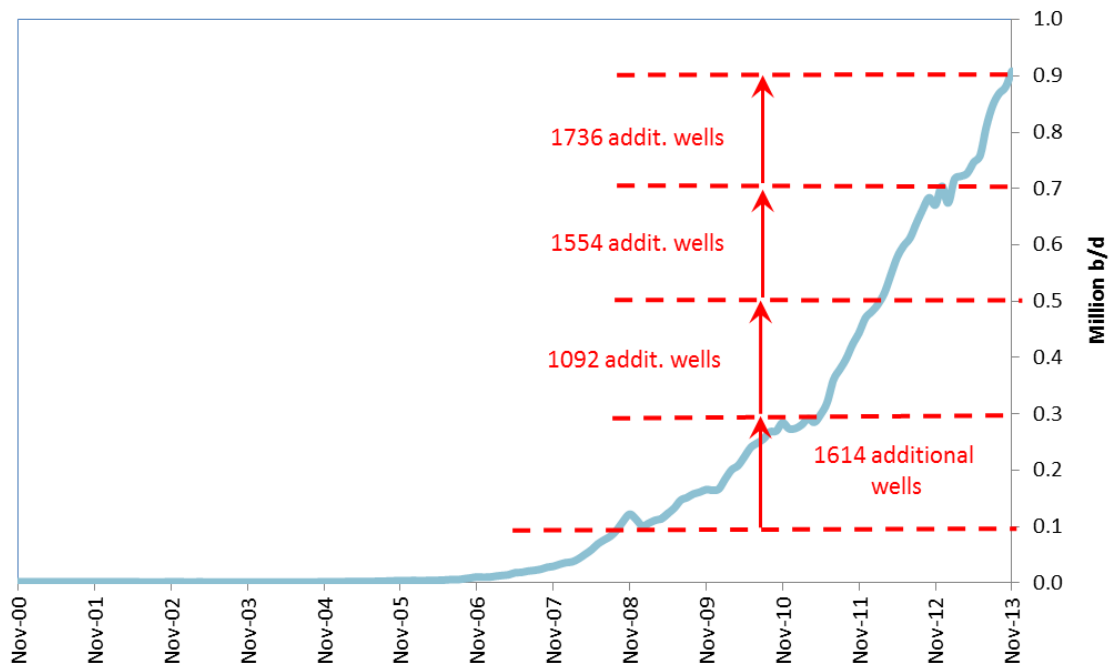
Source: DOE Data, North Dakota Industrial Commission, Independent Analysis

¹⁴ Rafael Sandrea, "Evaluating Production Potential of Mature US Shale Oil, Gas Plays," *Oil and Gas Journal*, 1 December 1, 2012.



While Bakken well performance did not increase dramatically from 2012 to 2013, there are impressive standouts among the industry. With several companies reporting strong well performance and we have seen consistent and large increases in IPs, and estimated ultimate recovery (EUR) over the past several years.

Figure 5: Bakken: production increase and total wells

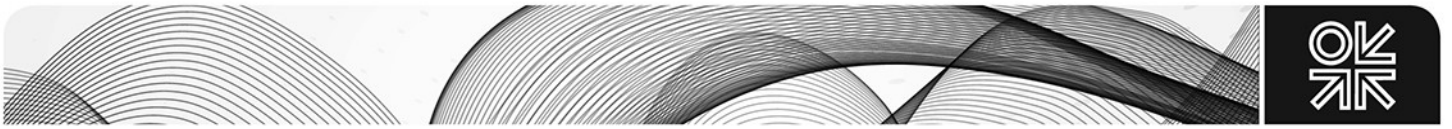


Source: DOE Data, North Dakota Industrial Commission, Independent Analysis

Overall, the cumulative drilling experience shows that these plays may be large in extent, but are not necessarily continuous or homogenous in scale; there are patches of strong well performance and repeatability within each play, some of which are better than others, but break evens still remain high and unpredictable for many companies. Small areas have top quartile performance in production, reserves and economic terms. And low gas and natural gas liquids (NGLs) prices and superlight liquids discounts, largely a function of rapid production growth, are putting further pressure on revenues. From the company data and industry capex surveys, it appears that capex will have to remain constant to maintain production at current levels, and surely increase if production is to keep growing during this industrial buildup phase.

In this context, from an economic perspective, the shale gas and tight oil business may be analogous to an equation that operators have yet to solve, but this has yet to be understood by some operators, policymakers and analysts. And based on an holistic review of the consensus and experience to date, the equation may still not be workable for a few more years, if at all. One of the top priorities, apart from everything the industry is doing, such as reducing field complexity, is to increase the efficiency of supply chain synchronization in this new 'E&P manufacturing' process.

This new industry has been focused on drilling; the drilling of infill wells is likely to remain the focus for years to come as companies delineate acreage spacing, increasing the longevity of these plays and



the span of drilling that may require decades not years. But who can, or will want to, fund the drilling of millions of acres and hundreds of thousands of wells at an ongoing loss? The lifetime capex for just the Appalachian and Permian exceed \$1.5 trillion.¹⁵ After all, the benevolence of the US capital markets cannot last forever for all players, especially the marginal players, regardless of how deep and specialized the US market is. A more realistic outcome is that sections of the industry will have to restructure and focus more rapidly on the most commercially sustainable areas of the plays, perhaps about 40 per cent of the current acreage and resource estimates, possibly yielding a lower production growth in the US than is currently expected, but perhaps a more lasting one. Ironically, this dramatic change may just be what the industry needs to maintain growth. Outside of the US, the revolution is still a distant hope.

Acknowledgements

Special thanks to Trisha Curtis at EPRINC for her valuable comments and reviews, Antonio Merino, Chief Economist at Repsol, Rafael Sandrea, and Energy Aspects.

¹⁵ TPH Global Shale Conference, 21 November 2013; Lifetime well count times average well costs